Yield and nutritional value of the commercially more important fish species

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Yield and nutritional value of the commercially more important fish species

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Aberdeen, Scotland, UK

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PREPARATION OF THIS DOCUMENT

The completion of food balance sheets and the consequent calculation of the contributions of various foods to national diets form an important part of the work of FAO. No systematic revision of these nutritional coefficients for use in the calculation of the contribution of fish to national diets has been undertaken since this work began in the late nineteen-forties. In the meantime, however, there has been a large increase in the detail concerning the species produced and consumed and in the methods of processing; the work presented in this paper is an attempt to attach nutritional factors to as many of these products as possible.

This study has been undertaken by the Torry Research Station (Aberdeen, Scotland, UK), on a contract basis for the Fishery Information, Data and Statistics Service, Fisheries Department, Food and Agricultural Organization of the United Nations. It is based on original published material, from which suitable yield and composition data have been derived for the major species comprising the world catch.

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ABSTRACT

The study is in three parts. The first gives, in tabular form the selected values of yield and composition, a list of about 130 species or groups of related species in order of the current English name. Three yield figures are listed, the yield of skinless fillets from finfish, the yield of total edible flesh from finfish and the yield of edible meat from shellfish. The data on composition are the protein content, the fat content and, for molluscs, the glycogen content. The energy value is calculated from the composition. Table 2 is a list of the same species in order of their taxonomic codes as used in FAO's Fishery Statistics. Comparison with the "Systematic list of aquatic organisms" printed in the FAO Yearbook of Fishery Statistics may enable the user to apply the selected data in Table 1 to other related species, and may also indicate where further data collection and interpretation would be desirable to complete gaps in the coverage of the field.

Part two of the study is a description of the collection, assessment and treatment of the available data with some discussion of the significance of the results.

Finally, Part 3 consists of a series of "Monographs". Each deals with an individual species or group of species: it includes the data collected on yield and composition, the selected, preferred, values of yield and composition, brief notes on the reasons for the selections and a list of the sources of the data. The species, or groups listed, include with a few exceptions such as reduction species, almost all those with an annual world catch exceeding 100,000 metric tons.

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PART 1 - INTRODUCTION AND TABLES

Introduction

This paper gives the values of the yield of edible tissue and the protein and fat contents of the world's commercially more important fish and shellfish species, derived from a survey of published, and some unpublished, material. The information is intended to assist FAO in estimating the contribution of fish to the nutrition of individual countries from their data on catches, landings and disposal. Much of the data collected is insufficiently comprehensive, especially in relation to yield, to allow definitive estimates to be made: many of the selected values are considered provisional, or tentative.

Data of the yield and composition (as a percentage of the edible portion) of the species surveyed are presented in Table 1. Much of the published data on which Table 1 is based is of less value than it could be, because of the universal failure of authors to appreciate the many factors that can affect yield and composition. A high proportion of the individual measurements in the literature are from a small number of fish, sometimes only one, caught on a single occasion. The possible effects on both yield and composition of the date of catching, the location, the size of the fish and natural variability have selfom, if ever, been fully taken into account. Yield measurements are particularly variable: it is not impossible to find published yields for a species that vary by a factor of 2. Apart from the factors already mentioned as causing variability, all authors have failed to define exactly terms such as "fillet" and "edible portion".

The separate yields of skinless fillets and total edible flesh allow some flexibility in assessing the actual amount of fish tissue consumed in particular countries. In many developed countries a high proportion of fish is eaten in the filleted condition, with no bones or with pinbones only present, and often without skin. The remaining edible tissue is consigned with the bones, offal and possibly skin to fish meal manufacture, when it may contribute only indirectly to human nutrition. The extent to which skin is eaten is not addressed here since reliable information is lacking. In other countries, including most developing countries, fish is sold to the consumer either in the whole, gutted condition, or in some dressed or split form. In these circumstances nearly all the muscle tissue will be eaten and the "edible flesh" column in Table 1 is an estimate of such consumption. In any particular case a decision will need to be made on which yield figure is most suitable. (An intermediate figure could be appropriate.)

Yields are given to the nearest whole number, protein and fat contents to the first decimal place and energy values to the nearest whole number.

Energy values have been calculated using the factors:

Protein	4.27 kcal/g
Fat	9.02 kcal/g
Glycogen	4.11 kcal/g

1 kcal = 4.185 kJ

General notes on Table 1:

a) Because of the inadequacy of the collected data many of the selected values of yield and some values of composition are considered tentative or provisional: these figures are in square brackets.

b) For each listed species, the Monograph giving fuller details will be found in Part 3, either under the English name of the species or as indicated in a numbered footnote.

c) The species or groups listed include, with a few exceptions such as species used mostly for reduction to fish meal, almost all those with an annual world catch exceeding 100,000 metric tons (MT) per year (together with some additional species that were considered at the same time).

d) Selected values of yields are given as percentages of the whole weight of the fish.

e) Selected values of protein and fat content are given as percentages of the edible tissue, muscle in the case of finfish, but including other organs in many shellfish.

f) Where two or more figures are given in a single column, this is explained in a numbered footnote.

g) The separate yields of skinless fillets and total edible flesh allow some flexibility in assessing the actual amount of fish tissue consumed in particular countries. In many developed countries a high proportion of fish is eaten in the filleted condition, with no bones or with pinbones only present, and often without skin. The remaining edible tissue is consigned with the bones, offal and possibly skin to fish meal manufacture, when it may contribute only indirectly to human nutrition. The extent to which skin is eaten is not addressed here since reliable information is lacking. In other countries, including most developing countries, fish is sold to the consumer either in the whole, gutted condition, or in some dressed or split form. In these circumstances nearly all the muscle tissue will be eaten and the 'edible flesh' column in Table 1 is an estimate of such consumption. In any particular case a decision will need to be made on which yield figure is most suitable. (An intermediate figure could be appropriate.)

h) Yields are given to the nearest whole number, protein and fat contents to the first decimal place and energy values to the nearest whole number.

i) Energy values have been calculated using the factors:

Protein	4.27 kcal/g
Fat	9.02 kcal/g
Glycogen	4.11 kcal/g

1 kcal = 4.184 kJ

Comment on the exercise:

Much of the published data on which Table 1 is based, is of less value than it could be, because of the universal failure of authors to appreciate the many factors that can affect yield and consumption. A high portion of the individual measurements in the literature are from a small number of fish, sometimes only one, caught on a single occasion. The possible effects on both yield and composition of the date of catching, the location, the size of the fish and natural variability have seldom, if ever, been fully taken into account. Yield measurements are particularly variable: it is not impossible to find published yields for a species that vary by a factor of 2. Apart from the factors already mentioned as causing variability, all authors have failed to define exactly terms such as 'fillet' and 'edible portion'.

As far as possible, the data have been obtained from original sources, not from other compilations or from abstracts.

Table 1

Yield and composition of surveyed species, in order of English name

Species (see notes page 10)	Yield (as % of whole fish or shellfish weight)		Composition (as % of edible portion)			Energy Value	
	Skinless Fillet	Edible Flesh	Meats	Protein	Fat	Glycogen	Kcal	Kjoules
Akiami paste shrimp			[100]	[16.2]	[1.3]		[81]	[338]
Alaska pollack	36	41		16.6	0.6		76	319
Albacore (1)	[30]	58		23.7	4.6		143	597
Amberjacks nei	[46]	[53]		22.0	2.3		115	480
American cupped oyster (2)			10	8.5	1.8	2.7	64	266
American plaice (3)	34	49		17.6	1.6		90	375
Anchoveta (4,28)	[51]	62		18.0(20.2)	2.8(4.2)		102(124)	427(519)
Anchovies nei (4,28)	[51]	62		18.0(20.2)	2.8(4.2)		102(124)	427(519)
Argentine hake (5)	41	53		17.8	2.5		99	412
Argentine shortfin squid (6)			67	17.9	1.3		88	369
Atka mackerel	[34]	[54]		[17.5]	[4.0]		[111]	[464]
Atlantic cod	34	47		18.1	0.8		56	234
Atlantic herring (29)	46	61		17.8	13.8(14.2/6.1)		200(204/131)	839(854/548)
Atlantic horse mackerel (7)	[46]	52		19.7	5.8		136	571
Atlantic mackerel	54	61		18.7	11.4		183	764
Atlantic redfishes	29	45		18.4	2.7		103	431
Bali sardinella (8)	[53]	65		20.2	4.5		127	531
Banana prawn (9)			57	20.5	1.3		99	415
Bigeye tuna (1)	[30]	58		23.7	4.6		143	597
Black Sea sprat (10)	[50]	[56]		[17.1]	[8.1]		[146]	[611]
Blue mussel			24	11.2	1.8	2.5	74	311
Blue whiting	28	49		18.4	0.3		81	340

nei = not elsewhere included

Species (see notes page 10)	Yield (as % of whole fish or shellfish weight)			Composition (as % of edible portion)			Energy Value	
	Skinless Fillet	Edible Flesh	Meats	Protein	Fat	Glycogen	Kcal	Kjoules
Bombay duck	–	[57]		[8.8]	[0.3]		[40]	[169]
Calico scallop (11,30)			[15],[6]	[16.0],15.8	[0.8],0.6	[2.9],2.4	[87],83	[366],346
California pilchard (12)	50	53		18.9	7.9		152	636
Cape hakes (5)	41	53		17.8	2.5		99	412
Cape horse mackerel (7)	[46]	52		19.7	5.8		136	571
Capelin	[57]	[60]		14.9	5.9		117	489
Central Pacific anchoveta (4,28)	[51]	62		18.0(20.2)	2.8(4.2)		102(124)	427(519)
Characins	[38]	[57]		[17.6]	[10.5]		[170]	[711]
Chilean hake (5)	41	53		17.8	2.5		99	412
Chilean jack mackerel (7)	[46]	52		19.7	5.8		136	571
Chub mackerel	46	57		20.4	9.5		173	723
Chum salmon (13)	[50]	62		20.5	6.3		144	604
Cichlids nei (14)	[37]	37		17.6	2.1		94	394
Clams nei (15)			[18]	10.8	1.1	3.9	72	302
Coho salmon (13)	[50]	62		20.5	6.3		144	604
Common carp	36	[54]		17.5	4.7		117	490
Common scallop (11,30)			[15],[6]	[16.0],15.8	[0.8],0.6	[2.9],2.4	[87],83	[366],346
Common squids (6)			67	17.9	1.3		88	369
Cunene horse mackerel (7)	[46]	52		19.7	5.8		136	571
Cupped oysters nei (2)			10	8.5	1.8	2.7	64	266
Cuttlefishes, bobtail squids (6)			[63]	17.9	1.3		88	369
Cyprinids nei (16)	36	[54]		17.5	4.7		117	490
Dagaas	–	[63]		[16.2]	[3.1]		[97]	[406]
Dentex seabreams, etc nei	40	54		19.9	2.2		105	439
European anchovy (4,28)	[51]	62		18.0(20.2)	2.8(4.2)		102(124)	427(519)
European hake (5)	41	53		17.8	2.5		99	412

nei = not elsewhere included

Species (see notes page 10)	Yield (as % of whole fish or shellfish weight)			Composition (as % of edible portion)			Energy Value	
	Skinless Fillet	Edible Flesh	Meats	Protein	Fat	Glycogen	Kcal	Kjoules
European pilchard	[50]	62		20.0	8.1		158	663
European plaice	34	49		17.6	1.6		90	375
European sprat	[50]	[56]		[17.1]	[8.1]		[146]	[611]
Filefishes (17)	[33]	[36]		18.8	0.7		87	362
Flathead mullet (18)	34	50		19.8	4.0		121	505
Freshwater bream (16)	36	[54]		17.5	4.7		117	490
Frigate and bullet tunas (1)	[30]	58		23.7	4.6		143	597
Goldstripe sardinella (8)	[53]	65		20.2	4.5		127	531
Green mussel (19)			24	11.2	1.8	2.5	74	311
Greenland halibut (3)	34	49		13.0	13.7		179	749
Haddock	35	48		18.6	0.2		81	340
Hairtails, cutlassfishes	46	59		20.1	3.9		121	506
Hard clam (15)			[18]	10.8	1.1	3.9	72	302
Indian mackerel (20)	[45]	57		20.4	3.2		116	485
Indian mackerels nei (20)	[45]	57		20.4	3.2		116	485
Indian oil sardine (8)	[53]	65		20.2	4.5		127	531
Indian scad (21)	[52]	[52]		21.3	2.5		114	475
Jack and horse mackerels nei (7)	[46]	52		19.7	5.8		136	571
Jacks, crevalles nei	[33]	56		[19.8]	[1.7]		[100]	[418]
Japanese amberjack (22,31)	[46]	[53]		22.0	2.3(12.3)		115(205)	480(857)
Japanese anchovy (4,28)	[51]	62		18.0(20.2)	2.8(4.2)		102(124)	427(519)
Japanese (Manila) clam (15)			[18]	10.8	1.1	3.9	72	302
Japanese claim (15)			[18]	10.8	1.1	3.9	72	302
Japanese flying squid (6)			67	17.9	1.3		88	369
Japanese jack mackerel (7)	[46]	52		19.7	5.8		136	571
Japanese pilchard	50	53		18.9	7.91		52	636

nei = not elsewhere included

Species (see notes page 10)	Yield (as % of whole fish or shellfish weight)			Composition (as % of edible portion)			Energy Value	
	Skinless Fillet	Edible Flesh	Meats	Protein	Fat	Glycogen	Kcal	Kjoules
Japanese scad (21)	[52]	[52]		21.3	2.5		114	475
Japanese scallop (11,30)			[15],[6]	[16.0],15.8	[0.8],0.6	[2.9],2.4	[87],83	[366],346
Japanese Spanish mackerel (23)	57	67		20.0	[4.4]		[125]	[523]
Jellyfishes	–	–		[0.8]	[0.1]		[4]	[18]
Kawakawa (1)	[30]	58		23.7	4.6		143	597
Largehead hairtail (24)	46	59		20.1	3.9		121	506
Mediterranean horse mackerel (7)	[46]	52		19.7	5.8		136	571
Milkfish	[46]	61		21.1	4.7		132	554
Mullets nei	34	50		19.8	4.0		121	505
Narrow-barred Spanish (king) mackerel (23)	57	67		20.0	[4.4]		[125]	[523]
Nile perch	[57]	[65]		[21.2]	[0.8]		[98]	[409]
North Pacific anchovy (4,28)	[51]	62		18.0(20.2)	2.8(4.2)		102(124)	427(519)
North Pacific hake (5)	41	53		17.8	2.5		99	412
Northern bluefin tuna (1)	[30]	58		23.7	4.6		143	597
Northern brown shrimp (9)			57	20.5	1.3		99	415
Northern prawn			[36]	16.8	1.0		81	338
Northern white strimp (9)			57	20.5	1.3		99	415
Ocean quahog (15)			[18]	10.8	1.1	3.9	72	302
Octopuses (6)			[79]	17.9	1.3		88	369
Pacific cod	30	41		17.3	0.7		80	335
Pacific cupped oyster			10	8.5	1.8	2.7	64	266
Pacific herring	[52]	60		17.8	11.6		181	756
Pacific saury	[52]	64		21.8	8.6		171	714
Penaeus shrimps nei			57	20.5	1.3		99	415
Pink salmon (13)	[50]	62		20.5	6.3		144	604

nei = not elsewhere included

Species (see notes page 10)	Yield (as % of whole fish or shellfish weight)			Composition (as % of edible portion)			Energy Value	
	Skinless Fillet	Edible Flesh	Meats	Protein	Fat	Glycogen	Kcal	Kjoules
Ponyfishes (Slipmouths) nei	-	[36]		17.9	[1.0]		[85]	[358]
Round sardinella (8)	[53]	65		20.2	4.5		127	531
Saithe	34	47		18.3	0.5		83	346
Sardinellas nei (8)	[53]	65		20.2	4.5		127	531
Scads	[52]	[52]		21.3	2.5		114	475
Scallops nei (30)			[15],[6]	[16.0],15.8	[0.8],0.6	[2.9],2.4	[87],83	[366],346
Scorpionfishes, etc nei (25)	29	45		18.4	2.7		103	431
Sea mussels nei (19)			24	11.2	1.8	2.5	74	311
Sea scallop (11,30)			[15],[6]	[16.0],15.8	[0.8],0.6	[2.9],2.4	[87],83	[366],346
Seerfishes nei	57	67		20.0	[4.4]		[125]	[523]
Short neck clams (15)			[18]	10.8	1.1	3.9	72	302
Silver hake (5)	41	53		17.8	2.5		99	412
Silver seabream (26)	40	54		19.9	2.2		105	439
Skipjack tuna	[46]	62		24.2	3.8		138	576
Snoek (24)	46	59		20.1	3.9		121	506
Sockeye salmon (139	[50]	62		20.5	6.3		144	604
South American pilchard (12)	50	53		18.9	7.9		152	636
Southern African anchovy (4,28)	[51]	62		18.0(20.2)	2.8(4.2)		102(124)	427(519)
Southern African pilchard (12)	50	53		18.9	7.9		152	636
Southern blue whiting (27)	28	49		18.4	0.3		81	340
Southern bluefin tuna (1)	[30]	58		23.7	4.6		143	597
Squids nei (6)			67	17.9	1.3		88	369
Stolephorus anchovies (4,28)	[51]	62		18.0(20.2)	2.8(4.2)		102(124)	427(519)
Striped venus (15)			[18]	10.8	1.1	3.9	72	302
Surf clam (15)			[18]	10.8	1.1	3.9	72	302

nei = not elsewhere included

Species (see notes page 10)	Yield (as % of whole fish or shellfish weight)		Composition (as % of edible portion)			Energy Value	
	Skinless Fillet	Edible Flesh	Meats	Protein	Fat	Glycogen	Kcal	Kjoules
Threadsail filefish (17)	[33]	[36]		18.8	0.7		873	62
Tilapias nei	[37]	37		17.6	2.1		94	394
Toli shad	[50]	[60]		19.8	[12.6]		[198]	[829]
Triggerfishes, durgons	[33]	[36]		18.8	0.7		87	362
Whiting	32	[49]		18.2	[0.4]		[81]	[340]
Yellowfin sole (3)	34	49		17.6	1.6		90	375
Yellowfin tuna (1)	[30]	58		23.7	4.6		143	597

nei = not elsewhere included

Notes to Table 1

1 Monograph entitled TUNAS
2 " " PACIFIC CUPPED OYSTER
3 " " EUROPEAN PLAICE
4 " " ANCHOVIES
5 " " HAKES
6 " " SQUIDS, ETC
7 " " JACK AND HORSE MACKERELS
8 " " SARDINELLAS
9 " " PENAEUS SHRIMPS NEI
10 " " EUROPEAN SPRAT
11 " " SCALLOPS NEI
12 " " JAPANESE PILCHARD
13 " " PACIFIC SALMON
14 " " TILAPIAS NEI
15 " " CLAMS
16 " " COMMON CARP
17 " " TRIGGERFISHES, DURGONS
18 " " MULLETS NEI
19 " " BLUE MUSSEL
20 " " INDIAN MACKERELS
21 " " SCADS
22 " " AMBERJACKS NEI
23 " " SEERFISHES NEI
24 " " HAIRTAILS, CUTLASSFISHES
25 " " ATLANTIC REDFISHES
26 " " DENTEX, SEABREAMS, ETC, NEI
27 " " BLUE WHITING

28 First figure in composition and energy columns is for whole fish, figure in brackets for flesh

29 First figure in fat and energy columns is the weighted mean of the second and third figures; the second figure is for Atlantic-caught and third figure for Baltic-caught fish

30 First figure refers to meat including roe, second figure to meat excluding roe

31 First figure in fat and energy column is for wild, second figure for farmed fish

Table 2

Species items included in Survey, in order of taxonomic codes

Taxonomic Code	Scientific Name	English Name	1985 catch (metric tons)
1,21(05)xxx,xx	Stolothrissa, Limnothrissa spp	Dagaas	116,397
1,21(05)001,05	Clupea harengus	Atlantic herring	1,519,202
1,21(05)001,07	Clupea pallasi	Pacific herring	292,723
1,21(05)012,xx	Sardinella spp	Sardinellas nei	847,767
1,21(05)012,03	Sardinella gibbosa	Goldstripe sardinella	108,543
1,21(05)012,04	Sardinella longiceps	Indian oil sardine	290,229
1,21(05)012,10	Sardinella aurita (= anchovia)	Round sardinella	162,169
1,21(05)012,23	Sardinella lemuru	Bali sardinella	54,058
1,21(05)013,01	Sardinops melanosticta (-us)	Japanese pilchard	4,722,862
1,21(05)013,02	Sardinops caerulea (-us)	Californian pilchard	372,344
1,21(05)013,03	Sardinops sagax	South American pilchard	5,814,448
1,21(05)013,05	Sardinops ocellata (-us)	Southern African pilchard	89,798
1,21(05)034,04	Hilsa toli (= Tenualosa toli)	Toli shad	146,754
1,21(05)059,01	Clupeonella delicatula (= cultriventris)	Black Sea sprat (Clupeonella)	402,889
1,21(05)064,01	Sardina pilchardus	European pilchard	921,061
1,21(05)066,01	Sprattus sprattus	European sprat	266,829
1,21(06)xxx,xx	Engraulidae	Anchovies	183,902
1,21(06)002,01	Engraulis encrasicolus	European anchovy	598,798
1,21(06)002,02	Engraulis japonicus	Japanese anchovy	349,336
1,21(06)002,07	Engraulis mordax	North Pacific anchovy	153,723
1,21(06)002,08	Engraulis ringens	Anchoveta (Peruvian anchovy)	986,796
1,21(06)002,12	Engraulis capensis	Southern African anchovy	323,239
1,21(06)015,03	Cetengraulis mysticetus	Central Pacific anchoveta	245,264
1,21(06)050,xx	Stolephorus spp	Stolephorus anchovies	244,181
1,22(02)001,01	Chanos chanos	Milkfish	336,518
1,23(01)009,02	Oncorhynchus gorbuscha	Pink (Humpback) salmon	301,086
1,23(01)009,03	Oncorhynchus keta	Chum (Keta, Dog) salmon	267,612

Taxonomic Code	Scientific Name	English Name	1985 catch (metric tons)
1,23(01)009,06	Oncorhynchus nerka	Sockeye (Red) salmon	150,794
1,23(01)009,08	Oncorhynchus kisutch	Coho (Silver) salmon	48,185
1,23(04)002,01	Mallotus villosus	Capelin	2,215,527
1,32(11)001,02	Harpadon nehereus	Bombay duck	119,229
1,38(01)xxx,xx	Characidae	Characins	154,452
1,40(02)xxx,xx	Cyprinidae	Cyprinids nei	186,018
1,40(02)001,02	Abramis brama	Freshwater bream	58,020
1,40(02)002,01	Cyprinus carpio	Common carp	490,438
1,47(02)001,01	Cololabis saira	Pacific saury	273,760
1,48(04)002,02	Gadus morhua	Atlantic cod	1,947,291
1,48(04)002,11	Gadus macrocephalus	Pacific cod	409,598
1,48(04)010,01	Melanogrammus aeglefinus	Haddock	377,548
1,48(04)015,01	Pollachius virens	Saithe (Pollock)	504,948
1,48(04)016,01	Theragra chalcogramma	Alaska pollack	6,132,334
1,48(04)033,01	Micromesistius poutassou	Blue whiting	660,619
1,48(04)033,02	Micromesistius australis	Southern blue whiting	106,199
1,48(04)034,01	Merlangius merlangus	Whiting	157,049
1,48(05)004,xx	Merluccius capensis, paradoxus	Cape hakes	541,815
1,48(05)004,01	Merluccius merluccius	European hake	131,774
1,48(05)004,04	Merluccius bilinearis	Silver hake	99,135
1,48(05)004,05	Merluccius gayi	Chilean hake	47,064
1,48(05)004,06	Merluccius hubbsi	Argentine hake	371,690
1,48(05)004,07	Merluccius productus	North Pacific hake	99,297
1,65(01)xxx,xx	Mugilidae	Mullets nei	162,348
1,65(01)001,02	Mugil cephalus	Flathead mullet	47,734
1,70(01)167,07	Lates niloticus	Nile perch	152,568
1,70(23)004,xx	Trachurus spp	Jack and horse mackerels nei	390,374
1,70(23)004,01	Trachurus trachurus	Atlantic horse mackerel	209,440
1,70(23)004,03	Trachurus japonicus	Japanese jack mackerel	173,775
1,70(23)004,05	Trachurus murphyi	Chilean jack mackerel	2,148,841

Taxonomic Code	Scientific Name	English Name	1985 catch (metric tons)
1,70(23)004,08	Trachurus mediterraneus	Mediterranean horse mackerel	120,319
1,70(23)004,13	Trachurus capensis	Cape horse mackerel	455,421
1,70(23)004,14	Trachurus trecae	Cunene horse mackerel	56,766
1,70(23)043,xx	Decapterus spp	Scads	318,669
1,70(23)043,07	Decapterus maruadsi	Japanese scad	71,666
1,70(23)043,08	Decapterus russelli	Indian (Russell's) scad	55,201
1,70(23)044,xx	Caranx spp	Jacks, crevalles, nei	102,318
1,70(23)048,xx	Seriola spp	Amberjacks nei	42,035
1,70(23)048,02	Seriola quinqueradiata	Japanese amberjack	150,961
1,70(35)xxx,xx	Leiognathidae	Ponyfishes (Slipmouths) nei	159,471
1,70(39)xxx,xx	Sparidae	Dentex (Porgies), seabreams, etc nei	102,866
1,70(39)121,08	Chrysophrys major	Silver seabream	44,299
1,70(59)xxx,xx	Cichlidae	Cichlids nei	101,805
1,70(59)052,xx	Sarotherodon, Tilapia spp	Tilapias nei	278,837
1,74(03)001,01	Thyrsites (= Leionura) atun	Snoek	57,669
1,74(04)xxx,xx	Trichiuridae	Hairtails, cutlassfishes	119,796
1,74(04)003,02	Trichiurus lepturus	Largehead hairtail	710,280
1,75(01)002,01	Scomber japonicus	Chub mackerel	1,739,889
1,75(01)002,05	Scomber scombrus	Atlantic mackerel	600,556
1,75(01)014,xx	Rastrelliger spp	Indian mackerels nei	342,237
1,75(01)014,03	Rastrelliger kanagurta	Indian mackerel	176,824
1,75(01)015,xx	Scomberomorus spp	Seerfishes nei	68,551
1,75(01)015,03	Scomberomorus commerson	Narrow-barred Spanish (King) mackerel	114,316
1,75(01)015,12	Scomberomorus niphonius	Japanese Spanish mackerel	121,135
1,75(01)023,xx	Auxis thazard, rochei	Frigate and bullet tunas	146,794
1,75(01)024,06	Euthynnus affinis	Kawakawa	92,597
1,75(01)025,01	Katsuwonus pelamis	Skipjack tuna	884,235
1,75(01)026,01	Thunnus thynnus	Northern bluefin tuna	36,993
1,75(01)026,05	Thunnus alalunga	Albacore	176,922
1,75(01)026,08	Thunnus maccoyii	Southern bluefin tuna	35,212

Taxonomic Code	Scientific Name	English Name	1985 catch (metric tons)
1,75(01)026,10	Thunnus albacares	Yellowfin tuna	713,293
1,75(01)026,12	Thunnus obesus	Bigeye tuna	243,653
1,78(01)xxx,xx	Scorpaenidae	Scorpionfishes, etc nei	61,042
1,78(01)001,xx	Sebastes spp	Atlantic redfishes	400,680
1,78(07)014,02	Pleurogrammus azonus	Atka mackerel	139,155
1,83(02)004,05	Pleuronectes platessa	European plaice	203,308
1,83(02)005,01	Reinhardtius hippoglossoides	Greenland halibut	80,236
1,83(02)014,01	Hippoglossoides platessoides	American plaice (= Long rough dab)	80,911
1,83(02)024,02	Limanda aspera	Yellowfin sole	203,149
1,89(03)xxx,xx	Balistidae	Triggerfishes, durgons	39,746
1,89(03)004,xx	Cantherines (= Navodon) spp	Filefishes	272,979
1,89(03)010,01	Stephanolepis cirrhifer	Threadsail filefish	256,529
2,28(01)001,xx	Penaeus spp	Penaeus shrimps nei	412,879
2,28(01)001,01	Penaeus aztecus	Northern brown shrimp	70,858
2,28(01)001,03	Penaeus merguiensis	Banana prawn	61,421
2,28(01)001,22	Penaeus setiferus	Northern white shrimp	44,596
2,28(04)002,03	Pandalus borealis	Northern prawn	193,191
2,28(07)009,03	Acetes japonicus	Akiami paste shrimp	222,608
3,16(07)008,xx	Crassostrea spp	Cupped oysters nei	168,024
3,16(07)008,01	Crassostrea gigas	Pacific cupped oyster	562,866
3,16(07)008,03	Crassostrea virginica	American cupped oyster	271,925
3,16(08)xxx,xx	Pectinidae	Scallops nei	75,191
3,16(08)003,07	Pecten yessoensis	Japanese scallop	229,924
3,16(08)003,09	Pecten maximus	Common scallop	20,224
3,16(08)014,04	Placopecten magellanicus	Sea scallop	104,929
3,16(08)030,01	Argopecten gibbus	Calico scallop	125,609
3,16(10)xxx,xx	Mytilidae	Sea mussels nei	135,454
3,16(10)001,05	Mytilus edulis	Blue mussel	554,756
3,16(10)001,10	Mytilus smaragdinus	Green mussel	61,623
3,17(04)045,01	Arctica islandica	Ocean quahog	195,173

Taxonomic Code	Scientific Name	English Name	1985 catch (metric tons)
3,17(10)020,01	Spisula solidissima	Surf clam	182,834
3,17(11)004,05	Venus gallina	Striped venus	27,348
3,17(11)018,01	Venerupis japonica	Japanese (= Manila) clam	166,134
3,17(11)041,xx	Paphia spp	Short neck clams	86,060
3,17(11)075,01	Mercenaria mercenaria	Hard clam	32,460
3,17(21)025,02	Corbicula japonica	Japanese clam	53,873
3,21(02)xxx,xx	Sepia spp, Sepiola spp	Cuttlefishes, bobtail squids	214,642
3,21(04)001,xx	Loligo spp	Common squids	119,570
3,21(05)010,03	Illex argentinus	Argentine shortfin squid	43,706
3,21(05)058,03	Todarodes pacificus	Japanese flying squid	192,466
3,21(09)xxx,xx	Octopodidae	Octopuses	210,102
3,21	Loliginidae, Ommastrephidae	Squids nei	852,553
3,99	Bivalvia	Clams nei	648,774
6,17(41)007,xx	Rhopilema spp	Jellyfishes	63,700

Source: FAO Yearbook of Fishery Statistics, Catches and Landings, Volume 64

PART 2 - METHOD OF WORK AND GENERAL CONSIDERATIONS

This part of the document describes in more detail the choice of species and the way in which the exercise was carried out.

Choice of species

The original aim was to consider all species whose most recent world catch exceeded 50,000 metric tons (MT) per year together with a few specially important species of a lower catch level. By omitting species caught mainly for fishmeal (Gulf and Atlantic menhaden, sandeels, Norway pout, for example), and many of the groups of species designated in FAO catch statistics as 'X nei ('nei' means 'not elsewhere included') it was hoped that about 120 species or groups of species could be covered. It was thought possible that no data would be available on a number of species. In practice, it has been found that, with relatively few exceptions, sufficient data emerged from a literature search to enable most species and groups to be dealt with, with the obvious and necessary exception of broad categories such as 'marine fish nei'. The collection and assessment of literature data began with the most heavily caught species and proceeded down the catch tonnage list. The assessment of the data and selection of preferred yield and composition values has been completed for about 130 species or groups down to a catch level of 100,000 MT per year, though the initial data collection has covered most species down to 50,000 MT per year.

It proved possible, and in some cases necessary, to look at related species together (hakes are a good example); these grouped species sometimes included species caught at less than 100,000 MT per year.

Collection of the data

As far as possible only original source data have been collected. In a very few cases, where the original literature was inaccessible for some reason, secondary sources such as abstracts and compilations have been admitted. References to the original literature were collected from various sources:

a) a full computer-based search of Food Science and Technology Abstracts from 1969

b) a card index and a computer-based file held in Torry Research Station

c) a library search of books, including previous compilations of data

d) personal files

e) cross references from known sources

f) random discovery

In reference to the last source, it was somewhat disconcerting, when looking up a known paper in a journal, to come across hitherto unknown papers of some value. This not uncommon experience does raise concern about the efficiency of abstracting services and of the means of searching abstracts.

No claim is made for comprehensiveness in the literature search carried out: additional sources continued to become known right up to the end of this exercise. Nevertheless, the amount of data available overall was higher than expected, but not consistently so.

Some species with a high catch level, Black Sea sprat for example, turned up almost no data, while species or groups much further down the catch tonnage table proved to have been extensively studied. Thus Dentex, seabreams, etc, n.e.i. (Sparidae) provided more data than could conveniently be assimilated, partly perhaps because it is a large family with many important genera, and partly perhaps because many species are highly esteemed edible fish and thus attract the attention of laboratory workers.

The failure of this survey and others to search the literature comprehensively is confirmed by the lack of really good agreement between selected values in this report and those in other compilations. It is recognised that Russian and Japanese literature is inadequately represented in this exercise and this almost certainly applies also to literature in other languages.

No attempt has been made to standardize the format of the bibliographic references cited throughout this document. Rather, they are cited in accordance with the style used by the system or service through which references to the original literature were found. In addition to these are numerous references to papers found through random discovery, that is to papers of interest not identified through any system or service, but only through examination of the same source documents. Despite the efforts made towards standardization and comprehensive coverage in these systems, it is obvious that individually they fall far short of the needs for a study of this kind.

Quality of collected data

Much of the data collected is of rather low quality, not because the actual measurements of yield and analytical results are themselves inaccurate, though a few clearly are, but because the authors have not given sufficient information to enable their results to be interpreted, or because they have not appreciated the possible variation in the quantities they have measured.

As far as adequacy of information is concerned, yield data in particular are universally ill-defined. The term 'fillet' is used without making it clear whether the skin is still present and how far the fillet has been trimmed to remove belly-flaps and small bones such as pin-bones. The term 'edible portion' and similar terms are widely used but are ill defined or, more commonly, not defined. Even within a single country, where the handling of fish should be consistent, marked differences are apparent: for example, in two extensive surveys of Philippine fish carried out around the same time, measurements of the edible portion of the same species often differ markedly, even by as much as a factor of 2 (for a species not included in the present survey).

As far as composition is concerned, it is not always clear whether the material analysed is muscle tissue only, or includes skin or even bone. A judgement has often to be made on whether to accept the data or not.

Many authors, as far back as last century, have expressed their awareness of the possible seasonal variation of composition (and, less often expressed, of yield), but few have attempted to fully investigate the problem, probably because to do so would usually be impracticably expensive in cost and time. Surveys of variation in composition throughout the year, or a major part of the year, are not rare. However most such surveys ignore the possibility of variation with location of catching, with the size of the fish, with the sex and with post-catching treatment. An ideal survey would analyse several fish of at least two sizes in the commercial range, of both sexes, at weekly intervals throughout the year or the period of availability, from all exploited grounds.

The yield, by a fully-described procedure, and the composition of the flesh would be determined as soon as possible after catching (though preferably after resolution of rigor mortis). The final calculated mean values of yield and composition should be weighted to correspond with the commercial catch distribution in time and place. The possibility of year to year variation should be investigated. Such an ideal survey has not, and probably never will be carried out.

Much of the available data comes from small numbers of fish: analyses of a single fish are not unknown even in recent work. It is often the case that the number of fish examined is not stated. Where the value in the literature is known to be a mean of a batch or of a number of batches, this information is usually given in the monographs in Part 3 of this report.

Where a species is caught over a wide area, the place of capture is often included in the details in the monographs. No actual evidence of a geographical effect on yield or composition has been discerned, except in the single case of Atlantic herring. The apparent absence of such an effect, generally, may be because of inadequacies in the data.

Use of collected data

a) listing of data

All the relevant, or apparently relevant, data collected have been listed in the monographs. Relevant data are those that relate to the particular species or group being studied, or to a closely related species or group. The extent to which related species can be called in support is discussed in more detail later, but it must be said that in some cases there was little choice in the matter, as the amount of data on the studied item was inadequate.

The collected data are listed in the monographs, separately for yield and composition: within each monograph the order of species usually follows that used in the 'Systematic list of aquatic organisms' printed in the FAO Yearbook of Fishery Statistics - Catches and Landings. In many cases the scientific names, or common names, of the species given in the source literature are not the current ones. Where clear identity of scientific names can be established, this is indicated in the monographs. In general, when a scientific name is not given in the literature, the data have not been listed: in a few cases accurate identification of common names was possible and the data were accepted. Within each species or genus, the data are not in any significant order. Similarly, the source references are listed in the order in which they were used (with a few exceptions) and so the order is of no significance; it is neither alphabetical nor chronological. Three or fewer authors are named in full: more than three are named as 'First author et al'.

The list of sources is separate for each monograph. Many references occur in two or more monographs: in the present form each monograph is complete in itself.

b) means and ranges in source data

The data collected can take several forms:

(i) a single figure, which may relate to a single fish, or may be the mean of a known or an unknown number of fish;

(ii) separate figures, for individual fish or different batches;

(iii) the range of values (i.e. maximum and minimum only) for a number of fish or a number of batches;

(iv) the range, together with the mean values, again of a number of fish or a number of batches;

(v) the mean and the standard deviation of the values for a number of fish.

As far as it can be discerned from the description of the work given by the original source, the data have been listed in the monographs in one of the above forms. Often it is not possible to know whether the figure quoted is for one fish or more. Standard deviations are very rarely available.

The data are normally listed with the number of significant figures given in the original source: in one or two cases unrealistic figures have been rounded to two decimal places.

c) assessment of data

As far as possible the selected, preferred, values of the yield and composition are based on comprehensive sets of data. Surveys covering all or a major part of the year, especially if they cover more than one fishing ground, are very desirable. Two concordant surveys are a rare luxury. Where surveys are available, additional data on smaller numbers of samples are generally discounted unless they appear to contribute additional useful information. Where surveys are not available, a judgement has always had to be made in deciding which results are to be incorporated in the calculation of the selected, preferred, value. In cases of doubt, results have been included rather than excluded.

d) calculation of selected values

Where two or more good surveys have been found, the selected values are the means of these results. Where only one survey is available, its results are often taken as the selected values, provided they are consistent with any remaining, more fragmentary, data. If surveys are felt to be not properly representative, means of the survey and other data are calculated.

In calculating overall mean values, the separate collected mean values or single values are used. When only a range is given in the original, the mean of the range is taken into any overall mean.

Means are always simple arithmetic means. It could be argued that the mean ought to be weighted in some way towards the more comprehensive or more reliable results. Unfortunately the basis for such weighting does not exist.

For instance, suppose that two sets of results are available, the mean of 100 fish caught in December and the mean of 10 fish caught equally in December and June. One could weight the results 10 to 1 in favour of the first set, because 10 times as many samples were studied. Alternatively, they could be weighted 2 to 1 in favour of the second set because fish were caught on two occasions instead of one. The latter is probably preferable in this particular example, but if only 2 fish had been examined in the second set of results, one in December and one in June, weighting in favour of the 100 result mean would appear more sensible. In any actual situation no weighting procedure can properly be justified, apart from the weighting implicit in the preference given to major surveys.

e) energy values

The energy values have been calculated using the following factors:

Protein	4.27 kcal/g
Fat	9.02 kcal/g
Glycogen	4.11 kcal/g

Conversion to kilojoules was by multiplying by 4.184.

There is no universal agreement on the factors to be used, despite long recognition of the desirability of having agreed factors. The factors above are USA values (ref. 1) for meat and fish, and are used in other recent FAO studies of food composition. In some countries average values for all foods are preferred. In the UK (ref. 2) the values used are:

Protein	4 kcal/g
Fat	9 kcal/g
Carbohydrate (as monosaccharide)	3.75 kcal/g

For a few random species of fish, these factors give energy values a few percent lower than those in Table 1, but the differences are unlikely to be important in practice.

Are related species similar?

In some cases, sufficient data are available on a particular species to enable mean values to be selected. In many cases, however, additional data must be found. There is a presumption that species that are taxonomically related will be biologically more similar to each other than to other more distant species and so should be similar in yield and composition. It has long been clear that species in the family Gadidae are very similar in composition, and, in particular, have a very low fat content. Clupeidae are known to have moderate to high, but seasonally varying, fat contents. It is not known, however, to what extent taxonomic propinquity can always predict compositional or yield similarity.

In the present exercise additional data, when required, has been sought initially in the same genus as the species under study, and, with less confidence, in other genera of the same family. When two or more species of the same genus have come within the scope of the present exercise they have generally been considered together. Thus all Merluccius species are dealt with in the same monograph and no significant differences between species were found. Similar results with Sardinops, Sardinella, Engraulis, Oncorhynchus and other genera give some confidence in the belief that closely related species will be similar in yield and composition, though there are exceptions. When one considers the similarity between genera, the situation becomes more difficult. In cases where fish of a different genus have had to be included in the data collected for a particular species or group, in the absence of adequate data within its own genus, it has usually been found that the variability of the results masks any differences between genera. When related genera have been studied separately, in different monographs, differences between genera may become apparent, as the amount of data is greater. All Gadidae studied did prove to be similar, but this was not so for Clupeidae, Scombridae or Carangidae, three extensively studied families. For example, in Clupeidae, the selected fat contents of Clupea harengus and C.pallasi are 13.8% and 11.6%, while the value selected for Sardinella species is 4.5%. Among Scombridae, the fat content varies from 3.2% for Rastrelliger species to 11.4% for Scomber scombrus, while protein is 18.7% in Scomber scombrus and 24.2% in Katsuwonis pelamis.

Less marked differences are seen in Carangidae. Some of the variation may arise from the incomplete nature of the data, but it seems likely that different genera within a family may often, but not always, be somewhat different in composition. Because of the greater variability of the data, conclusions about yields are less certain.

The conclusion, tentative at the moment, is that while species in the same genus are likely to be quite similar, species or groups in different genera may differ significantly. Care must therefore be exercised when trying to apply data for one species to any other than a closely-related species.

Appropriate yield figures

Two yield figures have been derived for most finfish, of skinless fillets and of total edible flesh. In many developed countries fish is sold to the consumer mainly in the form of fillets, often skinless, usually closely trimmed, or as products made from blocks of skinless fillets. The literature, it has already been said, seldom gives an indication of how the fillet has been prepared and trimmed. Small differences in filleting traditions in different countries will mean that an average fillet yield based on results for several countries will hide such differences. In theory one might try to chose a fillet yield appropriate to a particular country from results obtained in that country, but in practice the variability and/or inadequacy of the data would make such an attempt difficult to justify.

Fillet yields are sometimes known, and sometimes suspected, to include skin. Where necessary the presence of skin has been allowed for by subtracting 5% of the fillet yield. This is, of course, a rough approximation since the thickness of fish skin can vary greatly between species. It was not felt to be realistic to try to estimate the proportion of skin in individual species: some data are available, especially in Russian literature, but only for a small number of species.

Some fish skin is eaten and will make some nutritional contribution. The high connective tissue content of skin means that its quality as protein is low.

This may be a partial justification for excluding it from fillet (and flesh) yield. In any case, no significant information appears to be available on the extent to which fish skin is eaten in different countries.

In many countries, especially developing countries, it is much more usual for fish to be supplied to the consumer either whole, usually gutted and often headed, or in a dressed or split form, perhaps smoked or dried. In these cases the opportunity exists for all the edible flesh to be consumed. The total edible flesh values selected for each species are intended to give a measure of such consumption. Again, as for the fillet yield, the variability of the available data is high. Part of the variability will result from the different methods used to recover the flesh; the exact procedure is seldom indicated in the original sources. In a very few cases the flesh yield is from trials with deboning machines. It is claimed that these machines can recover up to 50% more edible flesh than by filleting, but not all the data support this. It is not impossible to find a quoted yield by deboning that is lower than the fillet yield. One possible explanation of this anomaly is that the machines have been used on a batch basis in the laboratory rather than on a continuous commercial basis.

The ratio of the selected values of total flesh yield to those for fillet yield is often surprisingly low. One must suspect that some of the total flesh yields in the literature are actually fillet yields (possibly including belly flaps), but unless this is certain the data have been accepted at face value.

Final Considerations

This exercise has not attempted to address questions such as loss of nutritive value after catching (much of the data refers to recently caught fish) by leaching and spoilage, losses by infestation and waste at different stages. It might be suggested that a detailed questionnaire to appropriate authorities in each country might supply some data on these questions and also, perhaps, on the forms (fillet, whole etc) consumed and to what extent skin is eaten.

Implicit in many comments in this part of the document is the hope that future studies of yield and composition will be more extensive and planned to answer the need for the sort of data that has proved difficult to obtain and that the description of the work and the results are more detailed.

References

1. Merrill, A.L. and Watt, B.K. Energy value of foods - basis and derivation. Agriculture Handbook No 74 (US Dept of Agric. 1973)

2. Paul, A.A. and Southgate, D.A.T. McCance and Widdowson's The Composition of Foods. 4th edition (HMSO, London, 1978)

PART 3 - MONOGRAPHS

Yield is indicated as the percentage of the whole fish or shellfish weight
Composition is indicated as the percentage of the edible portion

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AKIAMI PASTE SHRIMP

Acetes japonicus 2,28(07)009,03

No data on this particular species have been found. The shrimp is used, probably almost exclusively, in the manufacture of a fermented product, a fish paste. The method of production is to mix the whole shrimps with salt, allow to drain after a few days, then pack into containers for at least 3 months. Further pressing or air-drying to reduce moisture content may occur.

Yield

The liquid drained off at an early stage may be evaporated to make a fermented fish sauce. Effectively therefore the edible yield is [100%].

Composition

Source 1 gives the composition of shrimps of an Atya species, which is used in the Philippines in the same way as Acetes in China, Korea and other countries. This is the only analysis that has been found of a whole small tropical shrimp. The selected values are from this source. No information has been found on whether changes occur in the chitin of the shrimp shell, leading to the appearance of additional nutrients compared with the original shrimp.

Selected values

Protein	[16.2%]
Fat	[1.3%]

Sources

1. Intengan, C.L. et al. Composition of Philippine foods, V. Philippine, J. of Science 85 203-213 (1956)

ALASKA POLLACK

Theragra chalcogramma **1,48(04)016,01**
(Walleye pollack)

Yield

Fillet	Edible Flesh	Comments	Source
35.4–55.0 38.5–53.2		skin-on: two different grounds: mean not given	1
28.9–38.6		skinless: mean not given	1
39.1±2.4		±SD(50 fish): skin-on: range 33.6–46.9	2
35.5±2.6		±SD(50 fish): skinless: range 30.7–43.3	2
	41.7	by deboning machine: double pass	3
35.5		skinless	4
19.7	40.2	single batch: filleted by machine, then trimmed and skinned	5

Selected values

Skinless fillets	36%
Edible flesh	41%

Selected values are based, in the case of fillets, on the values from source 2, and, in the case of total edible flesh, on the mean of the two available results. The latter value is surprisingly low in comparison with the fillet yield.

Composition

Protein	Fat	Comments	Source
12.7-15.7	0.2 -1.1	Ranges for five fishing grounds at different seasons	1
14.6-15.5	0.7 -1.0		
14.5-16.3	0.4 -0.7		
14.3-17.4	0.2 -0.4		
16.0-16.6	0.5 -0.6		
14.3	1.2		
15.4-16.8	0.20-0.32		
15.4-16.7	0.16-0.31		
17.0-18.0	0.19-0.23		
13.3-16.1	0.6 -1.1		
15.7	0.3		
15.8	0.5	Estimated means of above data	
18.9 (16.4-19.3)	0.98 (0.6-1.3)	Means and ranges of 8 analyses (total of 60 fish)	6
13.56	0.11	Means of single batch of commercially supplied fillets	7
18.32	0.86	Five fish combined	2
16.38	0.32	Collected data	8

Selected values

Protein 16.6%
Fat 0.6%

Selected values are based on the unweighted average of the mean values from each source.

Sources

1. Kizevetter, I.V. Technological and chemical characteristics of commercial fish of the Pacific Ocean Basin. (TNIRO, Vladivostok, 1971) pp168-169

2. Karl, H., Manthey, Monika and Schreiber, W. Investigations into frozen Alaska Pollock (Theragra chalcogramma). Fleischwirtschaaft 63 965-967 (1983)

3. Miyauchi, D., Kudo, G. and Patashnik, M. Effect of processing variables on storage characteristics of frozen minced Alaska pollock. Marine Fisheries Review 39 (No 5) 11-14 (1977)

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Sources (continued)

5. Babbitt, J.K., Koury, B., Groninger, H. and Spinelli, J. Observations on reprocessing frozen Alaska pollock (Theragra chalcogramma). J. Food Sci.49 323-326 (1984)

6. Stansby, M.E. Chemical characteristics of fish caught in the North East Pacific Ocean. Marine Fisheries Review 38 (No 9) 1-11 (1976)

7. Meinke, W.W., Finne, G., Nickelson, R. and Martin, R. Nutritive value of fillets and minced flesh from Alaska pollock and some underutilized finfish species from the Gulf of Mexico. J. Agric. Food Chem. 30 477-480 (1982)

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AMBERJACKS NEI

Seriola spp 1,70(23)048,xx

and

JAPANESE AMBERJACK

Seriola quinqueradiata 1,70(23)048,02

Yield

Fillet	Edible Flesh	Comments	Source
39.1		Seriola grandis: skinless: mean of six fish	1
55.2		S. grandis: includes skin	2

Selected values

Skinless fillets 46%
Edible flesh 53%

The value for fillets is the mean of the two widely different figures listed (after correcting the second for presence of skin): it cannot be considered very reliable. The value for total edible flesh, in the absence of any data, is based on values for other carangids.

Composition

Protein	Fat	Comments	Source
22.8	1.9	Seriola quinqueradiata: wild	3
20.5	12.9	S. quinqueradiata: farmed	3
22.9	5.4	S. quinqueradiata: wild: means of dorsal and ventral muscles	4
22.4	16.1	S. quinqueradiata: farmed: means of dorsal and ventral muscles	4
21.27	1.20	S. quinqueradiata: farmed	5
	8.0	S. quinqueradiata: farmed	6
20.1	1.4	S. lalandi	7
23.2	3.2	S. lalandi: means of three fish	8
22.54	3.12	S. lalandi: one fish	9

Protein	Fat	Comments	Source
20.1	1.4	S. lalandi	2
23.4	2.9	S. lalandi: one fish	10
22.5	1.6	S. dumerili	2
21.4	1.2	S. grandis: mean of six fish	1
22.5	1.3	S. grandis	2

Selected values

Protein	22.0%
Fat (wild)	2.3%
Fat (farmed)	12.3%

It is proposed in source 3 that the fat content of farmed S. quinqueradiata is consistently much higher than that of wild populations. The data collected appear to support this. (The low value for farmed fish from source 5 is probably because the fish were young.) There is no difference in protein content between wild and farmed fish. The selected values are means of the relevant data.

Sources

1. Vlieg, P. Proximate analysis of commercial New Zealand fish species-3. New Zealand J. Technol. 1 181-185 (1985)

2. Bykov, V.P. Marine Fishes. (Russian Translation Series 7, A.A. Balkema, Rotterdam, 1985) pp 51-52

3. Saeki, K. and Kumagai, H. Muscle components of wild and cultured yellowtail. J. Fd Hyg. Soc. Japan 20 101-105 (1979)

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7. Tulsner, M. The technological properties and processing possibilities of important northwest African commercial fish species. Fischerei-Forschung, Wissenschaftliche Schriftenreihe 3 55-63 (1965)

8. Simmonds, C.K. and Heydenrych, C. Composition of South African commercial fish species. Annual Report, Fishing Industry Research Institute 38 72 (1984)

Sources (continued)

9. van Wyk, G.F. South African fish products. Part VIII. Composition of the flesh of Cape fishes. J. Soc. Chem. Ind. (Trans.) 63 367-371 (1944)

10. Evans, A.A. and Wessels, J.P.H. Fatty acid composition of various fresh and canned products and one smoked fish product. Annual Report, Fishing Industry Research Institute 38 115-117 (1984)

ANCHOVIES

Engraulidae 1,21(06)xxx,xx

The available data, particularly on yield, are not sufficiently comprehensive, in respect of seasonal and geographical variation, for any of the species included in this study. All the data have therefore been combined to give selected single values for all Engraulidae. The following species and groups, falling within the scope of this study, are therefore included here:

ANCHOVIES NEI	Engraulidae	1,21(06)xxx,xx
EUROPEAN ANCHOVY	Engraulis encrasicolus	1,21(06)002,01
JAPANESE ANCHOVY	Engraulis japonicus	1,21(06)002,02
NORTH PACIFIC ANCHOVY	Engraulis mordax	1,21(06)002,07
ANCHOVETA (PERUVIAN ANCHOVY)	Engraulis ringens	1,21(06)002,08
SOUTHERN AFRICAN ANCHOVY (CAPE ANCHOVY)	Engraulis capensis	1,21(06)002,12
CENTRAL PACIFIC ANCHOVETA	Cetengraulis mysticetus	1,21(06)015,03
STOLEPHORUS ANCHOVIES	Stolephorus spp	1,21(06)050,xx

Yield

Fillet	Edible Flesh	Comments	Source
	61.0	E. encrasicolus	1
	61.2	E. encrasicolus	2
	64.2	E. encrasicolus: Spain: single sample of 21 fish	21
	77.8	E. encrasicolus: definition of 'edible flesh' not clear	3
	74.1	E. encrasicolus: definition of edible part not clear	4
	57-64	E. japonicus: yield of gutted, headed fish	1
	60.0	E. japonicus	5
	63.8	E. anchoita	1
	61.6	E. mordax	6
	51	E. mordax	2
	64.3	E. ringens: yield of gutted, headed fish	7
	64.5	Anchoa nasus: yield of gutted, headed fish	7

Selected values

Skinless fillets	51%
Edible flesh	62%

The value for total edible flesh is the mean of values quoted, but omitting those where definition of edible flesh is not entirely clear and those which give gutted, headed weight rather than edible flesh.

Composition

It is common for these very small fish to be eaten whole (sometimes described as "whitebait"); in addition to data on the composition of the edible flesh, therefore, information on the composition of the whole fish has been collected and assessed separately.

a) Whole fish

Protein	Fat	Comments	Source
15.66	0.78	Engraulidae: Philippines: no other information	8
20.2	2.6	Engraulis encrasicolus	2
19.0	13 June 8 July 7 August	E. ringens: monthly means of 15 to 20 fish: Chile	9
19.7	5.2	E. capensis: mean of 9 fish	10
14.81	1.98	Stolephorus commersonii: Philippines: single sample	11
20.74	1.40	S. commersonii: Philippines: single sample	12
17.82	0.29	S. commersonii: India: combined sample of 5 fish	13
18.74	3.9	S. malabaricus: India: combined sample of 5 fish	13
19.49	1.51	S. indicus: Philippines: single sample	12
14.52	1.38	S. tri: India: combined sample	14
17.4	2.3	Anchoa spp: Gulf of Mexico: median values over 4 seasons	15

b) Edible flesh

Protein	Fat	Comments	Source
18.6-22.9 mean 21.2	0.94-5.97 mean 2.65	E. encrasicolus: caught off Vigo, Spain: 29 batches (362 fish) caught over full year	16
21.80	3.72	E. encrasicolus: Italy	17
21.81	3.55	E. encrasicolus: Gulf of Naples: single sample: protein calculated from nitrogen content	4
18.40	1.67	E. encrasicolus: Spain: mean of 36 fish caught at same time	3
23.0	3.3	E. encrasicolus	2
	7.6 November 7.0 January 4.0 March	E. encrasicolus: Italy: monthly means: total of 1255 fish, analyzed is lots of 50 fish	20
21.18	3.20	E. encrasicolus: Spain: single sample of 21 fish	21
	1.3-10.7 mean 4.74	E. japonicus: Japan: mean of 8 lots of 20 fish, caught over 6 months	18
13.3-21.0	3.3-18.0	E. japonicus	2
17.3-19.1	0.7-9.2	E. mordax	2
	4.2	E. ringens	7
20.9	0.25	Stolephorus commersonii: Philippines: single sample	11
	2.8	Anchoa nasus	7
18.1	6.9	Various species, not readily identifiable: data include those for E. japonicus given by source 2: overall means of all data taken	19

Selected values

a) Whole fish

Only one set of data, from source 15, can be regarded as an approach to a year-long survey of composition and it relates to relatively minor Anchoa spp. The data from source 9 are the only Engraulis results clearly covering an extended period. Overall means of all the data have been taken as the selected values.

Protein 18.0%
Fat 2.8%

b) Edible flesh

The data from sources 16 and 18 have more seasonal coverage than others, though the latter has data only on fat content. Overall means of all the data are consistent with these more comprehensive surveys.

Protein	20.2%
Fat	4.2%

Sources

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2. Bykov, V.P. Marine Fishes. (Russian Translation Series 7, A.A. Balkema, Rotterdam, 1985) pp 94-85

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4. Carteni, A. and Aloj, G. Chemical composition of marine animals of the Gulf of Naples. Quaderni della Nutrizione 1 49-63 (1934)

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8. Valenzuela, A. Composition and nutritive value of Philippine food fishes. Philippine J. of Science 36 235-242 (1928)

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18. Hayashi, K. and Takagi, T. Seasonal variations in lipids and fatty acids of Japanese anchovy, Engraulis japonica. Bull. Fac. Fish. Hokkaido Univ. 29(1) 38-47 (1978)

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20. Viviani, R. et al. First observations on seasonal changes of the lipids in the tissues of some Adriatic clupeids. Rivista Italiana delle Sostanze Grasse 45 779-790 (1968)

21. Gimenez, J.C. and de las Heras, A.R. Composition and energy value of some fish eaten in Madrid. Trabajos del Instituto Español de Oceanografía No 17 (1943)

ATKA MACKEREL

Pleurogrammus azonus 1,78(07)014,02

Some of the small amount of data collected relates to the similar species, Pleurogrammus monopterygius (also called atka mackerel).

Yield

Fillet	Edible Flesh	Comments	Source
39.3		Pleurogrammus monopterygius: skinless	1
29		P. monopterygius: skinless	2
	57.2	P. monopterygius: includes skin	3
	51.85	P. azonus: skinless	4
	54.2-66.6 mean 59.8	P. sp: includes skin	5

Selected values

Skinless fillet [34%]
Edible flesh [54%]

The difference between the fillet yields from sources 1 and 2 is ascribed in source 1 to the presence of mature gonads in one of the batches. The mean value has been selected. The values for total edible flesh have been averaged after correcting for skin, where necessary, by a 5% reduction.

Composition

Protein	Fat	Comments	Source
17.4	4.4	Pleurogrammus monopterygius: means of two batches at different seasons	1
16.2	3.8	P. monopterygius	3
16.4-20.1 mean 18.6	0.5-4.4 mean 2.1	P. azonus: means of monthly batches over complete year	4
14.1-21.2 mean 17.9	0.3-10.9 mean 5.5	P. sp: means of several grounds and seasons	5

Selected values

Protein [17.5%]
Fat [4.0%]

The selected values are the means of the collected data.

Sources

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ATLANTIC COD

Gadus morhua

1,48(04)002,02

Yield

Fillet	Edible Flesh	Comments	Source
42.0		skinless fillets: % of gutted, head-on weight	1
42.0		skinless fillets: % of gutted, head-on weight	2
36.0		skinless fillets: % of whole weight	2
46.0		skin-on fillets: % of gutted, head-on weight	3
41.3		skinless fillets: % of gutted, head-on weight	3
38.9		skinless, trimmed, V-cut fillets: % of gutted, head-on weight	3
40-47.2 mean 45.5		skin-on fillets: cut by machine: % of gutted, head-on weight	4
37.0		skinless fillets: % of gutted head-on weight	5
	56.0 49.0	sum of fillet yield and yield of flesh recovered from filleting waste: % of gutted, head-on weight	5
	64.6	species not stated: edible yield as % of gutted headless fish	6
41.0		skinless fillets: % of gutted head-on weight	7
	51.0	total recovered mince: % of gutted head-on weight	7
46.0		skinless fillets: % of gutted, headless weight	8
	75.0	recovered flesh: % of gutted, headless weight	8
	52.2 53.9	edible meat: % of whole weight	9

Selected Values

Skinless fillets 34%
Edible flesh 47%

Cod is typically landed either gutted with head-on, or gutted, headless (often described as "dressed"). Mean values of yield of skinned fillets and of skin-on fillets have been converted to a whole fish basis by the use of factors obtained from sources 2, 9, and 10 and an overall mean value then derived. Similarly, the tabulated yields of total edible flesh have been converted to a whole fish basis, then averaged.

Composition

(a) Surveys

Protein	Fat	Comments	Source
17.94±0.86		±SD: 295 fish: analysed over complete year: caught mainly in North Sea and Atlantic	11
18.16±0.63		±SD: 182 Fish: analysed over complete year: caught in North Sea and Atlantic	12
	0.73±0.15	±SD: 182 fish: analysed over complete year: caught in North Sea and Atlantic	3
18.06±0.61	0.15±0.06	±SD: 37 fish: analysed over complete year: caught around Iceland	13
18.36		144 fish: analysed in February, May and October: caught in North Sea	3
16.82	0.30	20 batches: analysed over two complete years: caught in Baltic Sea	14
	1.01	12 batches: analysed each month of complete year: caught off Nova Scotia	15
17.43±0.89		±SD: 73 fish: caught February, March, April in Baltic Sea	3
	0.57-0.74	12 monthly batches of 8 fish: caught off East Coast of Canada	16
18.1±0.9		±SD: at least 8 batches caught over spring, summer and autumn: caught at Iceland	17
19.6±1.4		±SD: at least 8 batches caught over spring, summer and autumn: caught inshore USA	17
	0.034-0.45	analysed each month: Baltic Sea	24

Composition

(b) Other data

Protein	Fat	Comments	Source
18.1	0.3	Norwegian fish	18
18.2	0.77	single catch: Canada	19
16.9–19.4 mean 17.8	0.0–0.3 mean 0.2	no further information given	9
15.0–19.0	0.1–0.9	10–13 samples: probably North Sea	1
18.3±0.6		fish selected to give wide range of sizes: Norway	20
17.25±0.83	0.63±0.27	±SD: 40 fish	21
18.42	0.42	single batch: USA	22
16.0	0.48	single batch: Northwest Atlantic: protein calculated by difference	23

Selected Values

The data have been divided above into surveys covering all or part of the year, and more limited data. Only the former are used to derive recommended values: the latter are listed to allow comparison over greater geographical and, possibly, size ranges.

Protein 18.1%
Fat 0.8%

The protein value is a simple average of the means from sources 11, 12, 13, 14 and 17. The fat value is an average of means from sources 3, 15 and 16. The unused data arise from measurements using methods that are known to give incomplete extraction of fat.

Sources

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15. Dambergs, N. Extractives of fish muscle. 4. Seasonal variations of fat, water-solubles, protein and water in cod (Gadus morhua L.) fillets. J.Fish. Res. Bd. Canada 21 703-709 (1964)

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ATLANTIC HERRING

Clupea harengus 1,21(05)001,05

Yield

Fillet	Edible Flesh	Comments	Source
43.0		skinless: % of whole weight	
	61.0	by deboning machine: sum of yields from fillets and backbone: % of whole weight	1
	80.0	by deboning machine: % of headed, gutted weight	2
53.0		skin-on: % of whole weight	3
	67.5	includes skin: % of whole weight	4
51.1		probably skin-on: % of whole weight	5
	65.0	by deboning machine: % of whole weight	6

Selected values

Skinless fillets	46%
Edible flesh	61%

To derive the figure for fillets, the values from sources 3 and 5 were reduced by 10% to take account of the skin and then combined with the value from source 1 to give an average figure. The value for edible flesh from source 2, which is a percentage of the headed, gutted weight, has been converted to a whole fish basis. Sources 4 and 6 give data on the yield of headed, gutted fish from whole fish, which average 72.75%; this figure is used to convert the 80% yield from source 2, to 58.2% based on whole weight. The figure from source 4, was reduced by 10% to correct for the skin. These two converted figures were combined with those from sources 1 and 6 to give the selected value.

Composition

Protein	Fat	Comments	Source
17.7	5.2	spring spawning } Baltic herring	
7.3	8.2	autumn spawning } sampled over most of year	7
18.94	2.4	mean of 16 fish, caught at same time: West Atlantic	8

Protein	Fat	Comments	Source
16.9	12.4	different seasons: Norway	9
17.3	14.9		
17.03±0.87	14.46±4.50	±SD: mean of 40 fish, origin not stated	10
15.0	14.7	means of a number of fish, caught during one month	11
-	14.6	mean of 91 samples caught throughout season; caught in three successive years: North Sea	12
-	5.0	mean of 66 samples caught throughout season: caught in two successive years: Baltic	12
-	17.5	mean of several thousand analyses: North Sea and Atlantic	13
-	10.5	mean of 346 samples of Canadian herring, caught over a season	14
17-21	2.4-10	Baltic	ranges at different seasons; number of not known	4
18.0-19.7	5.6-22.5	North Atlantic		
16-19	12-26	North Sea fish		

Selected values

Protein 17.8%
Fat 13.8% (Atlantic 14.2%, Baltic 6.1%)

The data listed exclude many single analyses, those of limited range and some older work. Thorough studies of composition throughout the catching season are surprisingly few for such a well-studied species. A lot of scientific work has been devoted to the relationship between fat and water contents in this species.

The selected protein value is the mean of values from sources 7, 9 and 4, which give results over an extended period: the other analyses listed are from smaller samples, and are consistent with the selected value.

The selected fat content is a weighted mean of separate values chosen for Atlantic and Baltic herring: it is assumed that 5% of the total catch is from the Baltic. The separate figure for Atlantic herring is the mean of those from sources 12, 13 and 14, sources which cover the catching season in the three areas concerned. For Baltic herring, often considered a sub-species, the values from sources 7 and 12 are averaged.

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ATLANTIC MACKEREL

Scomber scombrus 1,75(01)002,01

Yield

Fillet	Edible Flesh	Comments	Source
55.3		Adriatic sea: sampled monthly over complete year	1
	53.3	US Atlantic coast: 10 monthly samples of 8-10 fish	2
	90.6	yield by deboning machine from headed and gutted fish	3
	66.1	Spain: mean of 3 fish	4
45.8			5
53-68			6
	57.7	mean of 2 fish	7

Selected values

Skinless fillets 54%
Edible flesh 61%

It is seldom entirely clear from the literature quoted whether the data definitely refer to fillet yield or to total edible flesh. The value from source 3, based on headed and gutted fish, gives a yield of 65.2% when converted to a whole fish basis using data from source 2. The selected values are the means of the collected data. They are somewhat higher than the values selected for chub mackerel (S. japonicus). It is possible that some of the above data include skin, which would give a higher apparent yield.

Composition

Protein	Fat	Comments	Source
	0.60-12.02 mean 6.41	Adriatic sea: monthly over complete year: total of several hundred fish	1
18.6	10.1	US Atlantic coast: 10 monthly samples: values calculated from separate white and dark muscle data	2
18.8	13.8	S.W. England: 11 batches over a year	8
	1.3-25.0 mean 12.3	S.W. England: 6 bi-monthly batches	9

Protein	Fat	Comments	Source
13.9–19.4 mean 17.3	10.4–28.7 mean 21.0	US Atlantic coast: 26 fish over a year: probably include skin	10
18.28	11.1	Italy	11
17.5	8.0	Spring, Nova Scotia	12
18.1	15.3	Autumn, Nova Scotia	12
18.3	1.8	Spring, Nova Scotia, means of 8 or 9 fish	13
17.5	20.6	Autumn, Nova Scotia, means of 8 or 9 fish	13
	2.0–25.6 mean 9.8	W. Atlantic: 11 batches over a year: total of 119 fish	14
	1.1–28.0 mean 11.1	Three grounds: sampled over whole part of year	15
16.5–24.2 mean 20.9	0.9–22.3 mean 9.9	means of 5 grounds	6
19.1	10.7	mean of 2 fish	7
18.6	5.4	Spring, Norway	16
18.5	20.2	Autumn, Norway	16
18.78	0.74	means of 3 fish	4
17.14	11.10		17
16.4–18.4	19.3–28.7		18
17.2–19.6	5.3–18.8	ranges of composition in fish of different sizes	19
	10.9 15.8	values of two different batches	20
19.6	5.1	one batch	21

Selected values

Protein 18.7%
Fat 11.4%

Seven sources, 1, 2, 8, 9, 10, 14 and 15, have studied the species over all or most of the year.

Data from source 10 are not internally consistent, the frequency of sampling is not clear and the sample analysed probably included skin. The fat content from source 1 is surprisingly low and probably represents an untypical population. Sources 10 and 1 are therefore excluded from the selection of representative values: those selected are means of the remaining data.

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ATLANTIC REDFISHES

Sebastes spp **1,78(01)001,xx**

Data for individual species of Sebastes and related genera have been collected. The selected values will also, therefore, be valid for the following.

SCORPION FISHES

Scorpaenidae **1,78(01)xxx,xx**

Yield

Fillet	Edible Flesh	Comments	Source
33.6		Sebastes marinus: includes subspecies marinus and mentella: mean of 37 fish caught together	1
27.5	47.0	S. marinus: edible flesh by deboning machine	2
	49.6	S. marinus	3
	47.3	S. mentella	3
29.0		Sebastodes (= Sebastes)alutus: mean of 16 fish	10
27.1		Sebastodes (= Sebastes)alutus: mean of 147 fish caught at different times	22
29.9		Sebastes alutus	11
31.5		S. proriger	11
28.9		S. reedi	11
	46.5	Sebastodes (= Sebastes)brevispinis: edible flesh by deboning machine	13
28.0	40.5	Sebastodes (= Sebastes) pinniger: edible flesh by deboning machine	14
28.0	41.7	Sebastodes (= Sebastes) flavidus: edible flesh by deboning machine	14
16.9-40.5 mean 26.3		Sebastodes (= Sebastes) pinniger and 4 other species: 180 fish	15
29.5		Helicolenus dactylopterus	16

Selected values

Skinless fillets	29%
Edible flesh	45%

The data do not demonstrate any consistent differences between Atlantic and Pacific redfishes, so all will be considered together. Source 22 comes closest to a seasonal survey but is limited geographically: the selected values are means of all the data.

Composition

Protein	Fat	Comments	Source
18.6	5.1	Sebastes marinus: includes subspecies marinus and mentella: means of 21 fish caught together	1
17.8	6.6	S. marinus	3
17.3	3.7	S. mentella	
18.0	1.1	S. marinus: means of 84 fish caught at 4 seasons	4
18.3	3.5	S. norvegicus (= marinus): mean of 2 fish	5
18.3	3.5	S. marinus	6
21.7	0.81	S. marinus: means of 17 or 19 fish	7
17.5	3.3	S. marinus	8
17.33	5.01	S. marinus: means of 40 fish	9
17.6	1.32	Sebastodes (= Sebastes)alutus	10
16.8–19.7	1.5–10.6	Sebastodes (= Sebastes)alutus	3
17.4–20.4 mean 19.2	0.36–4.03 mean 1.54	Sebastodes (= Sebastes)alutus: means of 147 fish caught at different times	23
19.0	1.7	Sebastes alutus + 7 other Sebastes spp: mean values	12
16.3–21.6 mean 19.0	0.56–4.10 mean 1.50	Sebastodes (= Sebastes)pinniger and 8 other spp: mean values of 223 fish, some caught over extended period, others not	15
18.7	2.9	means of 13 minor spp of Sebastodes (= Sebastes)	3
18.7	1.25	wild	17
19.1	7.31	farmed — Sebastes inermis: 3 fish each	
18.3	1.04	Sebastodes (= Sebastes) sp: means of 12 fish	18
19.0	2.26	Sebastodes (= Sebastes) melanops: means of 6 fish	19
18.2	1.84	Sebastodes (= Sebastes) pinniger: means of 6 fish	19
19.26	0.29	Sebastichthys capensis: means of 6 fish	20

Protein	Fat	Comments	Source
20.9	0.7	Helicolenus dactylopterus: means of 9 fish	21
17.3	5.3	Helicolenus dactylopterus	16
16.3	1.21	Helicolenus papillosus	22

Selected values

Protein 18.4%
Fat 2.7%

There are no consistent differences between Atlantic and Pacific redfishes, so all will be considered together. Seasonal surveys are limited: the selected values are overall means of all data (excluding only the non-typical data for the farmed species in source 17).

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BLUE MUSSEL

Mytilus edulis 3,16(10)001,05

The selected values are likely to be applicable to the following additional species and group coming within the scope of the study, although almost all the data collected refers to M. edulis.

SEA MUSSELS NEI

Mytilidae 3,16(10)xxx,xx

GREEN MUSSEL

Mytilus smaragdinus 3,16(10)001,10

Yield

Like oysters (see PACIFIC CUPPED OYSTER) the yield figures in the literature are likely to be particularly variable compared with fish and crustacea, because of the inherent variability of water content and the possibility, seldom made clear, that the shell liquor is included in the edible portion. An additional complication is that, commercially, mussels are commonly opened by heating. Partial cooking results and the shell liquor is lost. Cooking reduces the meat weight, while the loss of shell liquor will be significant if the yield is calculated on the cooked weight.

Edible Flesh	Comments	Source
19.4 13.5	cultivated natural *Mytilus edulis*: USA: opened by steaming	1
22.28	*M. edulis*: Spain: studied over range of grounds and seasons	2
42.8	*M. edulis*: India: includes shell liquor	3
16.50	*M. edulis*: India	5
15.00	*M. edulis*: India: cooked yield	6
27.79	*M. edulis*: USA: mean of 231 shellfish taken over 2 months	7
33.0	*M. crassitesta*: Japan: mean of 2 samples	16
20.0	*M. viridis*: India: single batch	17

Selected value

Edible flesh (raw) 24%

Data based on yield of cooked meats (sources 1 and 6) should be excluded, as should those of source 3, which include the shell liquor in the edible portion. The remaining data, which still vary from 16.50 to 33, are averaged to give the selected value: this value is in good agreement with the only seasonal survey (Source 2).

Composition

Protein	Fat	Glycogen	Comments	Source
14.1-21.0 mean 18.5	2.6-3.5 mean 3.1	1.2-5.8 mean 3.1	Mytilus edulis: USA: cultivated stock: opened by steaming: sampled 10 months of year	1
10.00-14.56 mean 12.70	1.30-3.04 mean 1.94	1.08-7.20 mean 3.15	M. edulis: Spain: studied over range of grounds and seasons	2
9.92	1.97		M. edulis: India:includes shell liquor	3
10.85	1.48	2.60	M. edulis: Spain: means of wild and cultivated stocks	4
20.42	2.01	0.95	M. edulis: India	5
15.31	2.54	2.71	M. edulis: USA	7
10.9-13.7	2.5	5	M. edulis: Korea	8
11.8	2.88	2.65	M. edulis: USA	9
9.66	1.74	1.88	M. edulis: UK: mean of 500 shellfish caught over 2 complete years	10
	2.7		M. edulis: India	11
12.13-13.82	2.24-2.55	8.31-10.58	M. edulis: India	12
	2.0		M. edulis: UK: mean of 6 samples over a year	13
10.5	1.6	2.8	M. edulis: Korea	14
8.7	1.1	4.1	M. edulis: USA	15
15.02	0.42	1.54	M. crassitesta: Japan: means of 2 samples	16
12.99	1.70		M. viridis: India: single batch	17

Selected values

Protein	11.2%
Fat	1.8%
Glycogen	2.5%

As in the yield calculation, sources 1 and 3 are excluded. There are two complete partial surveys, sources 2 and 10, and these are averaged to give the selected values. Among the other data, only the protein value of source 5 and the glycogen content from source 12 are in conflict with the selected values.

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BLUE WHITING

Micromesistius poutassou 1,48(04)033,01

and

SOUTHERN BLUE WHITING

Micromesistius australis 1,48(04)033,02

These two species are treated together, as they are very closely related and little data are available on southern blue whiting.

Yield

Fillet	Edible Flesh	Comments	Source
	43.9	*Micromesistius poutassou*: edible flesh by deboning machine	1
	35.1	*M. poutassou*: edible flesh by deboning machine	2
20.1 25.7 28.4 31.7		*M. poutassou*: skinless: hand filleted	2
32.3		*M. poutassou*: skinless: caught February to June	3
	56.7	*M. poutassou*: includes skin	4
	58.2	*M. poutassou*: includes skin	5
	59.2	*M. australis*: includes skin	4
	51.5	*M. australis*: includes skin	5
	51.2	*M. australis*: skinless	6
48.1		*M. australis*: skinless	7

Selected values

Skinless fillets	28%
Edible flesh	49%

The fillet yield from source 7 appears relatively high and may represent total edible flesh rather than commercial fillet yield. The mean of the remaining figures is selected. The values for flesh with skin are reduced by 5% and combined with the remaining data to give the flesh yield.

Composition

Protein	Fat	Comments	Source
16.1		Micromesistius poutassou	2
18.5	0.27	M. poutassou: 26 or 29 samples caught over several years and seasons	4
17.1	0.4	M. poutassou	5
18.1	0.8	M. poutassou	8
17	1.8	M. poutassou	9
18.7	0.7	M. poutassou	10
22.3	0.4	M. poutassou	11
16.4	0.3	M. poutassou	12
18.2		M. poutassou: mean of 5 fish	13
17.9		February	14
14.1		April — M. poutassou: probably washed	14
19.1	0.4	M. poutassou: English Channel: means of 10 fish caught at same time	15
17.4–19.4 mean 18.2	0.1–0.5 mean 0.3	M. australis: S. America: caught May, and August to December	16
15.2	1.5	M. australis	5
16.5	0.55	M. australis (probably)	6
17.3	0.59	M. australis: New Zealand	7

Selected values

Protein 18.4%
Fat 0.3%

Two sets of data, from sources 4 and 16, cover an extended catching period. Almost all the other data appear to refer to fish caught on one occasion only. The two extensive sets are in good agreement, although for different species, and their averages have been taken as the selected values.

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BOMBAY DUCK

Harpodon nehereus 1,32(11)001,02

Yield

Fillet	Edible Flesh	Comments	Source
	73.4	probably includes skin and bones: mean of 18 fish	1,2
	78.0	probably includes skin and bone	3

Selected values

Skinless fillets –
Edible flesh 57%

No data are available on fillet yield and it seems likely that no figure is required since Bombay duck has an exceptionally high water content and is very soft and so is unlikely ever to be consumed as fillets, either with or without skin. The collected values probably relate to the fish prepared for sun drying, i.e. beheaded and eviscerated. With this assumption it is possible to calculate the edible flesh by analogy with the related lizard fish, for which more complete data are given in source 1.

Composition

Protein	Fat	Comments	Source
8.2	0.1	1 fish analysed	1,2
9.05			3
	0.350		4
9.29	0.49		5
	0.3–0.4		6
8.54			7

Selected values

Protein 8.8%
Fat 0.3%

The selected values are means of all the data. They are provisional in the absence of any seasonal survey which might indicate the variability of composition.

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CAPELIN

Mallotus villosus 1,23(04)002,01

Yield

Fillet	Edible Flesh		Comments	Source
40.4-69.3 Mean 57.8		Spring	skin-on	1
55.4-66.8 Mean 62.2		Summer		
57.4-63.3 Mean 61.0		Autumn		
Mean 58.3		Winter		

Selected values

Skinless fillets	57%
Edible flesh	60%

Value for skinless fillets is obtained by averaging the data from source 1 and subtracting 5% to correct for presence of skin. Figure for total edible flesh is derived by analogy with other species. It is consistent with the data given in source 1 for the yield of "body", averaging 66.9%. "Body" includes skin, bone and fins.

Composition

Protein	Fat		Comments	Source
14.5-16.0 Mean 15.6	1.48-4.11 Mean 2.72	Spring	meat and skin	1
12.8-16.8 Mean 15.0	4.6 -22.5 Mean 11.4	Summer		
12.4-15.6 Mean 14.4	8.9 -23.2 Mean 13.4	Autumn		
13.0-15.8 Mean 14.6	5.4 -10.6 Mean 8.3	Winter		
14.96		mean of 30 fish	June: Canada	2
	2.8	mean of 54 fish		
14.2-17.0	2.1-4.3	April		3
12.6-16.4	2.1-4.4	May		
13.2-16.2	7.6-15.2	June, July		

Selected values

Protein 14.9%
Fat 5.9%

Values are simple averages of all the data above. Much more extensive analytical data are available on whole fish, because capelin has in the past been caught mainly for fish meal; these data are summarised in source 4.

Sources

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CHARACINS

Characidae 1,38(01)xxx,xx

Characins include a very large number of genera in South America and Africa. The data collected is limited to Bolivia and at least one of the species listed is often ascribed to a different, but related family, Curimatidae.

Yield

Fillet	Edible Flesh	Comments	Source
34.54		Prochilodus platensis: skinless	1
45.4		Prochilodus platensis: skinless	2
44.2		Colossoma macropomum: skinless	2
39.4		Colossoma brachypomum: skinless	2
27.1		Rhaphiodon vulpinnus: skinless	2
39.3		Serrasalmus naterri: skinless	2

Selected values

Skinless fillets [38%]
Edible flesh [57%]

The skinless fillet figure is the mean of the data collected. The edible flesh value is a likely maximum figure at 50% over the skinless fillet value.

Composition

Protein	Fat	Comments	Source
16.63-21.50 mean 19.63	0.11-2.23 mean 1.01	Prochilodus platensis	1
23.38	4.26	Prochilodus platensis	2
14.11	18.02	Colossoma macropomum	2
15.84	15.61	Colossoma brachypomum	2
15.05	13.39	Rhaphiodon vulpinnus	2

Selected values

Protein [17.6%]
Fat [10.5%]

The values selected are simple means of the available data. This is clearly an unsatisfactory position because of the wide variation between species, both in fat content and protein content. Prochilodus is very probably lower in fat and higher in protein content than the other species. If it were possible to separately identify the contribution of Prochilodus to catch statistics, separate values could be derived for it.

Sources

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CHUB MACKEREL

Scomber japonicus 1,75(01)002,01

Yield

Fillet	Edible Flesh	Comments	Source
	57.6 61.4	Means of ranges at two seasons	1
	50.0-62.2 mean 57.0		
	81.8	Values from 4 regions	2
	52-65		
	56.6		
	55.8		3
	54.4		4
45.5		probably skinless	5
	62.0	flesh and skin : 17 fish	6
47.2			13

Selected values

Skinless fillets 46%
Edible flesh 57%

For skinless fillets, the two available yield figures have been averaged; the result is consistent with that for other species. The edible flesh figure is the mean of all data above, with exceptions that the extreme value, 81.8, has been omitted, and the value from source 6 has been reduced by 10% to correct for presence of skin.

Composition

Protein	Fat	Comments	Source
20.6-23.2 mean 18.7		10 fish	7
	12.0	mean of 43 fish	8
23.0	2.1	means of 6 fish, caught at same time	5

Protein	Fat	Comments	Source
20.5	3.2		3
21.28	8.20	probably a single fish	9
19.8	7.6	means of 4 fish, caught at same time	10
16.1-24.3 mean 20.2	0.8-32.8 mean 10.3	ranges and means of fish from 5 grounds: different periods of year for each ground	1
20.7	8.3	means from 4 grounds, probably over extended period	2
	2.8-18.9 mean 10.6	range and mean of 23 fish: caught in 8 months of year	11
	7.5	mean of 8 fish: caught in 3 months of year	12
	8.5	mean of 27 fish: caught in 4 month of year	14

Selected values

Protein 20.4%
Fat 9.5%

The selected value for protein content is the mean of those from sources 1 and 2: all other data are consistent, but relate to small number of fish. Fat is taken as the mean of data from sources 1, 2, 8, 11, 12, 14, which studied fish over an extended period.

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CLAMS

The following species and groups come within the scope of this study.

	OCEAN QUAHOG	
Arctica islandica		3,17(04)045,01
	SURF CLAM	
Spisula solidissima		3,17(10)020,01
	STRIPED VENUS	
Venus gallina		3,17(11)004,05
	JAPANESE (= MANILA) CLAM	
Venerupis japonica		3,17(11)018,01
	SHORT NECK CLAMS	
Paphia spp		3,17(11(041,xx
	HARD CLAM	
Mercenaria mercenaria		3,17(11)075,01
	JAPANESE CLAM	
Corbicula japonica		3,17(21)025,02

Since species of several families are included in the collected data, the selected values of yield and composition will be adequate for the additional category:

	CLAMS, NEI	
Bivalvia		3,99

Much of the data collected relate to species other than those above.

Yield

Meat	Comments	Source
20.3	Arctica islandica: mean value at different locations	1
8.15	Cardium edule	2
30.0	Spisula solidissima	1
10.2	Meretrix meretrix: mean of values for 2 sizes	3
7.62-17.72 mean 11.22	Meretrix casta: mean of 28 samples over complete year	4
21.4	Venerupis semidecussata: mean of 5 batches at different times	5
10.1	Mercenaria mercenaria: mean of 2 batches	6
20.5	Donax spp	7
20	Corbicula leana: mean of 2 batches	5
32.4	Corbicula fluminea	7
11.0-20.4 mean 15.0	Corbicula sandai: 10 monthly samples	8

Selected values

Edible flesh [18%]

Two extensive surveys have been found (Sources 4 and 8): neither is of a prominent species. Variation within a species (shown by the two surveys) and between species is unusually high, partly, because a number of different families are involved, because the nature of the edible flesh is not defined, and because of seasonal variation in gonad size. The selected value is the mean of all the data, but is provisional because of the lack of a proper survey of a major species.

Composition

Protein	Fat	Glycogen	Comments	Source
	0.56		muscle } Arctica	
	0.13		hepatopancreas } islandica	9
11.8	1.0		Cardium corbis: mean of 10 specimens	10
	0.71		Mactra sulcataria	11
11.7	0.3		Spisula solidissima	12
15.6	0.34		S.solidissima: mean of 20 specimens	13
	0.88		S.solidissima: mean of 9 speciments	14
	1.2		Venus spp	15
10.94	0.67	2.68	Meretrix lusoria	16
	0.82		Meretrix meretrix lusoria	11
11.92	1.11	4.74	Meretrix meretrix: carbohydrate by difference	3
7.98-12.29 mean 9.80	0.50-1.89 mean 0.88		Meretrix casta: means of 28 samples over complete year	4
13.34	1.40	1.86	Venerupis semidecussata: means of 5 batches at different times	5
12.25	0.88	3.07	Tapes japonica	16
10.1			Tapes japonica	17
	0.77		Tapes japonica	11
13.0	1.23		Saxidomus nuttalli (= giganteus): means of 525 specimens in 21 batches	10
13.5	1.0		Protothaca staminea: 1 specimen	10
	0.5		Protothaca staminea: mean of 45 specimens	18

Protein	Fat	Glycogen	Comments	Source
10.7	0.3		Mercenaria mercenaria	12
	0.38		Mercenaria mercenaria: means of 8 samples	14
4.41	0.21		Mercenaria mercenaria: means of 19 or 20 samples	13
9.70	1.18		Mercenaria mercenaria	6
8.81	1.69		Donax spp	7
9.51	1.27		Mya arenaria: means of 20 samples	13
	2.18		Mya arenaria: mean of 7 samples	14
15.0	3.2		Panope (= Panopea) generosa: means of 7 specimens	10
	0.89		Corbicula japonica	11
11.13	1.60	4.78	Corbicula japonica	16
6.21	1.55		Corbicula fluminea	7
7.66	0.84		Corbicula leana: means of 2 batches	5
8.0–12.8 mean 9.76	1.8–3.5 mean 2.5	5.1–8.5 mean 6.4	Corbicula sandai: 10 monthly samples	8

Selected values

Protein	10.8%
Fat	1.1%
Glycogen	3.9%

As in the case of yield, only two extensive surveys have been found, both of minor species. Again as for yield, variability is quite high and no species differences are noticeable. The selected values are means of all the data.

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COMMON CARP

Cyprinus carpio 1,40(02)002,01

Other categories included in this monograph are:

FRESHWATER BREAM

Abramis brama 1,40(02)001,02

and

CYPRINIDS NEI

Cyprinidae 1,40(02)xxx,xx

Yield

Fillet	Edible Flesh	Comments	Source
32.6		Cyprinus carpio: mean of 6 fish	3
45.2		C. carpio	4
28.4	40.0	C. carpio: edible flesh by deboning machine	5
43.6		C. carpio	6
27.7		C. carpio: mean of 41 fish from 3 different sources	7
31.6		C. carpio: mean of 2 fish	8
43.0		C. carpio: includes skin: mean of 3 fish	9
50.8		C. carpio: includes skin	10
55.0		Ctenopharyngodon idella: includes skin	10
52.7		Hypophthalmichthys molitrix: includes skin	10
34.6		H. molitrix: mean of 7 fish	3

Selected values

Skinless fillets 36%
Edible flesh [54%]

A very wide range of values for fillet yield is available. Those from source 10 appear extreme and are excluded. After correcting the source 9 result for presence of skin, the overall mean is taken as the selected value. The single value for total edible flesh in collected data look a little low. The selected value is derived by applying a likely maximum 50% increase to the selected fillet value.

Composition

Protein	Fat	Comments	Source
17.8 20.6	2.6 2.9	Abramis brama: 2 batches (20 and 10 fish) in different years	1
19.1	1.32	A. brama	2
16.7	9.2	Cyprinus carpio: means of 6 fish	3
15.95	2.09	C. carpio	4
17.2 16.5	0.8 8.0	C.carpio: different feeding histories	6
17.9	5.1	C. carpio: means of 47 fish from 3 different sources	7
	2.0	C. carpio: mean of 2 fish	8
17.1	6.8	C. carpio: mean of 3 fish	9
16.9	10.9	C. carpio	10
16.3	2.38	C. carpio	11
18.6	4.5	C. carpio	12
17.9	4.2	Ctenopharyngodon idella	10
18.5	3.4	Hypophthalmichthys molitrix	10
16.7	6.4	H. molitrix: mean of 7 fish	3

Selected values

Protein 17.5%
Fat 4.7%

Like other species, carps can be expected to show seasonal variation in composition. In addition, however, as commonly cultivated species, their composition will be influenced by the nature and amount of feed supplied (as indicated by the data of source 6). Some data have been omitted from the table above as they refer to the results of experimental feeding. The selected values are means of all the data. Since fish given supplementary feed tend to have higher fat contents than wild or unfed fish, the selected value is probably low in relation to the mean fat content of fish currently consumed.

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DAGAAS

Stolothrissa, Limnothrissa spp 1,21(05)xxx,xx

Yield

No data have been found on yield.

Selected values

Skinless fillets -
Edible flesh [63%]

Dagaas are mainly sun-dried. It is unlikely that fillets will be a significant form in consumption, so no figure has been proposed. The tentative value for total edible flesh is based on other small Clupeid species.

Composition

Protein	Fat	Comments	Source
16.2	3.1	Probably relates to whole fish	1

Selected values

Protein [16.2%]
Fat [3.1%]

The only values found probably relate to whole fish since the 'ash' figure quoted is fairly high. The source is a secondary one; the original source has not been seen.

Source

1. FAO/US Dept. of Health, Education and Welfare. Food composition table for use in Africa. (1968) p 207

DENTEX, SEABREAMS, ETC, NEI

Sparidae 1,70(39)xxx,xx

and

SILVER SEABREAM

Chrysophrys major 1,70(39)121,08

An unusually large amount of data is available on Sparidae, perhaps because the family includes a fair number of different genera and a number of individually high-valued species. In order to cope readily with this quantity of data, two constraints have been applied. Firstly, only the more important genera have been included in the listed data: these are Pagellus, Dentex, Chrysophrys, Sparus (Pagrus) and Boops. Secondly, data from a single source for different species within a genus have been combined into a single mean and, where appropriate, range entry.

Yield

Fillet	Edible Flesh	Comments	Source
40.0	50.6	Pagellus: 4 species: fillet yield probably includes skin	1
40.3		Pagellus: 2 species: skinless	6
40-52 mean 43.9		Dentex: 4 species: probably includes skin	1
37.8		D. filosus: skinless	6
	51.8	D. vulgaris (= dentex)	8
36.2-58.7		Chrysophrys major: includes skin	1
32.7		Chrysophrys auratus: skinless: mean of 6 fish	10
42		Pagrus (= Sparus) ehrenbergii: skinless	6
	57.44	Sparus berda: skinless	13
	56.2	Box (= Boops) boops	8

Selected values

Skinless fillets	40%
Edible flesh	54%

The skinless fillet yield is the mean of the data, omitting those in which presence or absence of skin is uncertain, and correcting for presence of skin where appropriate. The total edible flesh value is the mean of all the data.

Composition

Protein	Fat	Comments	Source
17.0-22.5 mean 20.5	0.7-4.7 mean 2.2	Pagellus: 4 species	1
20.75	0.90	P. lithognathus: means of 6 fish	2
16.80	1.80	Pagellus: 2 species: total of 12 fish	3
16.22	1.76	Pagellus: 2 species: 2 fish	4
22.10	0.22	P. coupei	5
20.3	2.6	Pagellus: 4 species	6
19.23	0.46	P. natalensis	7
17.7-23.2 mean 20.3	1.0-5.8 mean 3.2	Dentex: 4 species	1
18.5-20.3 mean 19.4	0.6-1.9 mean 1.2	Dentex: 4 species	6
20.44	1.08	Dentex: 2 species: one species sampled quarterly	2
21.4	3.51	D. vulgaris (= dentex)	8
17.73	3.51	D. dentex	9
20.25	1.65	Chrysophrys major	1
19.4	1.6	Chrysophrys auratus: means of 6 fish	10
20.30	0.49	Chrysophrys auratus: means of 10 fish	11
23.13	1.15	Chrysophrys haffara	12
18.1-22.8 mean 20.6	0.2-6.3 mean 1.8	Sparus: 7 species	1
20.44	1.14	Pagrus (= Sparus): 4 species: means of 6 fish of each species	2
20.4	2.3	Pagrus (= Sparus): 3 species	6
20.30	1.49	Pagrus (= Sparus) pagrus: means of 8 fish	11
20.88	2.12	Sparus: 2 species	7
	3.24	S. aurata: mean of 4 seasons	14
17.13	1.38	S. cantabricus: 2 fish	4

Protein	Fat	Comments	Source
19.95	0.66	S. berda	15
21.85	0.51	S. berda	13
20.4	0.17	S. berda	16
19.5	4.1	Box (= Boops) boops	1
18.60	10.06	Box (= Boops) boops: means of 4 fish	3
19.28	2.71	Box (= Boops) boops: means of 2 fish	4
19.1	5.93	Box (= Boops) boops	8

Selected values

Protein 19.9%
Fat 2.2%

The data for Box boops might be taken to indicate a higher fat content than for the other genera and species considered. However individual measurements for other species (as in some of the data of source 1) are also moderately high and, on balance, Box boops has been included in the overall means selected.

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Source (continued)

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EUROPEAN PILCHARD

Sardina pilchardus

1,21(05)064,01

Yield

Fillet	Edible Flesh	Comments	Source
	60.4	Spain: 16 batches of fish: caught October to June (total of 131 fish): probably includes skin	1
	61.0	Portugal: probably includes skin	2
	64.2 62.1	Mediterranean) coasts of Spain: Atlantic) may include skin	8

Selected values

Skinless fillets [50%]
Edible flesh 62%

Value for skinless fillets is taken from the data on Japanese pilchard and other Sardinops spp. Edible flesh value is a simple mean.

Composition

Protein	Fat	Comments	Source
	15.9 2.5 1.4	November January March — Adriatic Sea: 900 fish analysed in batches of about 50 fish	3
20.0	5.8	Spain: 16 batches, caught October to June (total of 131 fish): probably includes skin	1
19.83	2.06-19.84 mean 10.24	Tunisia: monthly batches over full year: protein calculated by difference	4
17.55-21.34 mean 19.805	0.52-11.77 mean 5.905	North-east Spain: means of 64 lots over 3 full years (each lot of up to 40 fish): includes skin	5
18.4	11.4	South-west England: sampled over 3½ years: includes skin and bones	6
27.3 24 24.9	2 8.6 5.8	Spring Summer/Autumn Winter — Portugal: probably includes skin	2
	5.1-12.0 mean 8.7	Adriatic Sea: sampled over 6 months: includes skin and bones	7

Protein	Fat	Comments	Source
	10.99 Mediterranean)	coasts of Spain: sampled	
	11.05 Atlantic)	over complete year: may include skin	8
19.38	5.19	Gulf of Naples: single sample	9
20.2	8.9		10

Selected values

Protein 20.0%
Fat 8.1%

Values are based on simple means of data after excluding 4 sets of data: sources 6 and 7 are excluded as they include bone, source 9 as it is a single sample, and source 2 as the protein values appear unrealistically high.

Sources

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Pleuronectes platessa	EUROPEAN PLAICE	1,83(02)004,05
Reinhardtius hippoglossoides	GREENLAND HALIBUT	1,83(02)005,01
Hippoglossoides platessoides	AMERICAN PLAICE	1,83(02)014,01
Limanda aspera	YELLOWFIN SOLE	1,83(02)024,02

These four species in the family Pleuronectidae come within the scope of the study. Data, especially on yields, are lacking for most of these, so data on other Pleuronectidae have been collected below.

Yield

Fillet	Edible Flesh	Comments	Source
	61.8	Hippoglossus stenolepis: includes skin	1
28.0	34.0	Pleuronectes platessa: based on gutted weight: edible flesh by deboning machine	6
35.0		Pleuronectes platessa: based on gutted weight	7
44.0		Pleuronectes platessa: based on gutted weight: mean of 18 fish	2
	54.7	Platessa (= Pleuronectes) platessa: includes skin	1
	49.4	Hippoglossoides platessoides: skinless	1
	52.7	Hippoglossoides elassodon: includes skin	1
34.0	50.0	Limanda ferruginea: skinless fillets: edible flesh by deboning machine	12
	51.4	Limanda ferruginea: includes skin	13
	44.0	Limanda limanda: probably skinless	1
42.0		Microstomus kitt: based on gutted weight	7
27.0	51.5	Microstomus pacificus: edible flesh by deboning machine	15
	42.9	Platichthys stellatus: by deboning machine	17

Fillet	Edible Flesh	Comments	Source
24.9 48.0		Spring) Pseudopleuronectes americanus: Summer) means of 6 fish each	18
	60.2	Parophrys vetulus: by deboning machine	17
33.0	46.5	Parophrys vetulus: by deboning machine	15
28.2		mean of 240 fish of 9 spp of Pleuronectidae	20
40.3		mean of 18 fish of 3 spp of Pleuronectidae	21
29.1		mean of 47 fish of 4 spp of Pleuronectidae	22
	49.5	mean yield, with skin, of 9 spp of Pleuronectidae	23

Selected values

Skinless fillets 34%
Edible flesh 49%

There is a considerable range of values for yields, even within one species (source 18). No surveys appear to have been carried out. The selected values are means of all the data, after correcting for skin by subtracting 5%, or after converting to a round fish basis, using data of source 25.

Composition

Protein	Fat	Comments	Source
18.0	2.0	Hippoglossus hippoglossus	1
18.4	5.0	Hippoglossus vulgaris (= hippoglossus): means of 3 or 4 fish	2
20.1	1.22	Hippoglossus stenolepis: means of 19 or 21 fish	3
	2.33	Hippoglossus stenolepis: mean of 18 fish	4
21.2	0.8	Hippoglossus stenolepis (probably): means of 27 fish	5
17.38	0.98	Pleuronectes platessa: means of 40 fish	8
16.8	2.4	Pleuronectes platessa: means of 2-6 fish	2

Protein	Fat	Comments	Source
11.94-19.94 mean 16.66	0.49-4.21 mean 1.42	Pleuronectes platessa: means of 182 fish over complete year	24
12.8	16.1	Reinhardtius hippoglossoides	1
13.1	11.3	Reinhardtius hippoglossoides	9
16.0	6.2	Pleuronectes (= Glyptocephalus) cynoglossus: means of up to 7 fish	2
15.5	2.7	Hippoglossoides platessoides	1
15.31	0.55	Hippoglossoides platessoides	10
15.6	2.4	Hippoglossoides elassodon	1
19.7	1.2	Hippoglossoides elassodon	11
17.0	1.3	Limanda aspera	11
15.0	1.1	Limanda aspera	1
	1.7	Limanda ferruginea	14
17.0	1.94	Limanda ferruginea	13
22.3	0.37	Limanda ferruginea: means of 19 or 20 fish	3
15.5	0.8	Pleuronectes (= Limanda) limanda: means of 3 fish	2
	1.3	Limanda punctatissima	14
19.2	1.3	Lepidopsetta bilineata	11
17.4	2.2	Pleuronectes microcephalus (= Microstomus kitt): means of up to 5 fish	2
14.7	0.81	Microstomus pacificus: means of single batch of 100 fish	16
16.8	0.3	Pleuronectes (= Platichthys) flesus: 1 fish	2
18.5	0.53	Pseudopleuronectes americanus: means of 6 fish	18
19.9	0.3	Pseudopleuronectes americanus: means of 5 fish	19
18.5	1.8	Parophrys vetulus	11
16.1	1.40	Parophrys vetulus: means of single batch of 125 fish	16

Protein	Fat	Comments	Source
18.8	1.41	Eopsetta jordani: means of single batch of 160 fish	16
17.1	1.1	means of 240 fish of 9 spp. of Pleuronectidae	20
18.7	1.1	means of 18 fish of 3 spp.	21
17.6	0.13	means of 47 fish of 4 spp. of Pleuronectidae	22
16.9	3.5	means of 14 spp. of Pleuronectidae	23

Selected values

a) for Greenland halibut (Reinhardtius hippoglossoides)

Protein [13.0%]
Fat [13.7%]

b) other Pleuronectidae

Protein 17.6%
Fat 1.6%

Separate, provisional, values have been selected for Greenland halibut, since both analyses listed above would indicate that this species has a higher fat content and lower protein content than the other Pleuronectidae. This species is known to respond to processing in a variable way.

Of the other species, only one survey has been found (source 24), for European plaice. The selected values are the means of all the data, excluding Greenland halibut.

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Sources (continued)

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EUROPEAN SPRAT

Sprattus sprattus 1,21(05)066,01

Also included, because of lack of separate information, is:

BLACK SEA SPRAT

Clupeonella delicatula 1,21(05)059,01
(= cultriventris)

Yield

Fillet	Edible Flesh	Comments	Source
	80.7	Clupea (= Sprattus) sprattus: Spain: probably includes skin and bones: 2 batches at different times	1
	78.0	Sprattus sprattus balticus: Baltic: includes skin, bones and fins	2
	55.6	Sprattus sprattus phalericus: Black Sea: flesh only: 4 batches at different times	3
	74.0	Sprattus sprattus: UK: flesh and skin (probably bones also): one lot	4

Selected values

Skinless fillet [50%]
Edible flesh [56%]

The available data are inadequate. The selected value for skinless fillet yield is taken from Japanese Pilchard and other Sardinops spp. The value for total edible flesh is the value from source 3: other data may include skin, bone and fins. The value is consistent with those for other clupeoids.

Composition

Protein	Fat	Comments	Source
16.6	16.1	Clupea (= Sprattus) sprattus: Spain: probably includes skin and bone: 2 batches at different times	1
13.8	9.9	Sprattus sprattus balticus: whole fish analysed at 4 seasons	2
14.3	13.8	Sprattus sprattus phalericus: Black Sea: probably whole fish or gutted, headed fish: 4 batches at different times	3
17.1	14.5	Sprattus sprattus: UK: flesh only: one lot	4

Protein	Fat	Comments	Source
	5.3-10.1	Sprattus sprattus: Baltic: fillets (with skin?) analysed: range over year	5
	11.5-18.0	Sprattus sprattus: UK: whole fish: sampled over 5 months	6
	2.0	Clupea (= Sprattus) sprattus: Adriatic: fillet: mean of 2 samples	7
16.8	10.5	Sprattus sprattus: Norway: whole fish	8
15.8-17.3 mean 6.7	6.3-16.8 mean 11.3	Sprattus balticus: Baltic: whole fish: sampled monthly over complete year	9

Selected values

Protein [17.1%]
Fat [8.1%]

Most of the available data are for whole fish or edible parts that include bone. Of the remaining sets of data only one, source 4, has a protein measurement and relates to a single sample. It is taken as the selected value, with great reservations. Three sets of data, sources 4, 5, and 7, give fat contents of skinless or skin-on fillets. The selected value is the mean of these, but again is of limited validity because of the inadequate seasonal coverage.

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HADDOCK

Melanogrammus aeglefinus 1,48(04)010,01

Yield

Fillet	Edible Flesh	Comments	Source
40	57	% of gutted, head-on weight	1
38	52	% of gutted, head-on weight	2
42		% of gutted, head-on weight	3
41		% of gutted, head-on weight	4
	50.6	% of whole weight	5

Selected values

Skinless fillets 35%
Edible flesh 48%

After correcting the data from sources 1 to 4 to a whole weight basis, using a factor from source 6, all data were averaged to give the selected values.

Composition

Protein	Fat	Comments	Source
15.5–20.2 mean 18.8	0.05–1.3 mean 0.17	USA: 42 fish analysed over a year	7
18.6	0.13	USA: 9 samples throughout the year	8
15.75–20.69 mean 18.51		UK: 361 fish analysed over 2 complete years	9
17.2	0.2		5
14.6–20.3	0.1–0.6	UK: 29 to 44 samples	3
16.7–22.6 mean 20.4	0.03–0.23 mean 0.11	USA: 20 samples	10
19.7	0.3	Norway	11
19.58	0.12	USA: 2 lots	12
17.7		USA: several samples	13

Selected values

Protein	18.6%
Fat	0.2%

The selected values are means of data from surveys covering all or most of the year (sources 7, 8 and 9).

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HAIRTAILS, CUTLASSFISHES

Trichiuridae 1,74(04)xxx,xx

Insufficient data has appeared on largehead hairtail (Trichiurus lepturus) to allow separate treatment. Very little has been found on snoek (Thyrsites atun), belonging to the related family, Gempylidae. This monograph, therefore, relates to the following species or groups.

HAIRTAILS, CUTLASSFISHES

Trichiuridae 1,74(04)xxx,xx

LARGEHEAD HAIRTAIL

Trichiurus lepturus 1,74(04)003,02

SNOEK

Thyrsites atun 1,74(03)001,01

Yield

Fillet	Edible Flesh	Comments	Source
	65.4	Trichiurus lepturus: Nigeria: includes skin	1
50.7		T. lepturus: north west Africa: without skin	2
58.0		T. lepturus: probably includes skin	3
	23.9	Trichiurus haumela (= T. lepturus): India	4
	68.59	T. haumela (= T. lepturus): Philippines: may include skin	5
	52.5	T. haumela (= T. lepturus): Indian Ocean: includes skin	6
	61.4	T. haumela (= T. lepturus): Philippines: may include skin	7
	54.6-67.2	T. haumela (= T.lepturus)	8
	82.0	Trichiurus savala (= Lepturacanthis savala): India: may include skin	9
	62.0	T. savala (= L. savala): India	10
58.0		Lepidopus caudatus: eastern Atlantic: percentage of gutted, head-on, weight	11
32.3		L. caudatus: New Zealand: mean of 4 fish	15
51-62		L. caudatus: probably skin on	3
42.6		Aphanopus carbo: eastern Atlantic: percentage of gutted, head on, weight	11

Fillet	Edible Flesh	Comments	Source
43.8		Thyrsites atun: New Zealand: may include skin	12
	60.2	T. atun: includes skin	13
41.5		T. atun: New Zealand: mean of 6 fish	14

Selected values

Skinless fillets 46%
Edible flesh 59%

The result from source 11 for fillet yield has been converted to whole fish basis using data in source 3. Values with skin-on have been reduced by 5% and a final overall mean for fillet yield obtained.

In the case of total edible flesh, two results, from sources 4 and 9, have been excluded as extremes. Values with skin have been adjusted to skin off basis, and an overall mean taken.

Composition

Protein	Fat	Comments	Source
18.8	4.1	Trichiurus lepturus: north west Africa	2
21.6	5.3	T. lepturus	3
16.8	0.3	T. haumela (= T. lepturus): Philippines: may include skin	7
17.89	2.11	T. haumela (= T. lepturus): Philippines: may include skin	5
18.2	0.7	T. haumela (= T. lepturus): Indian Ocean: may include skin	6
16.0-21.8 mean 19.4	0.4-20.6 mean 6.8	T. haumela (= T. lepturus): several grounds and seasons: may include skin	8
22.01		T. savala (= Lepturacanthis savala): India	10
18.11	3.24	T. savala (= Lepturacanthis savala): India: may include skin	9
21.42	2.06	Trichiurus spp: India: may include skin	16
17.3	9.2	Lepidopus caudatus: eastern Atlantic	11
19.2	1.1	L. caudatus: New Zealand	15
20.3	3.0	L. caudatus	3

Protein	Fat	Comments	Source
	1.6-13.2	Aphanopus carbo: eastern Atlantic	17
21.3	3.8	Thyrsites atun: South Africa: 10 fish	18
24.0	3.0	T. atun: South Africa: 2 fish	19
21.0	4.9	T. atun: New Zealand	12
19.3	3.3	T. atun: New Zealand	14
18.74-23.26 mean 21.91	0-11.92 mean 5.15	T. atun: South Africa: sampled monthly: total of 46 fish	20
22.0	1.7	T. atun: Australia: 2 lots: total 6 fish	21
21.1-22.3 mean 21.7	0.8-13.0 mean 6.3	T. atun	13

Selected values

Protein 20.1%
Fat 3.9%

No definite species difference can be discerned, so all species are considered together. Despite evidence, notably from source 8, that the fat content is variable, only one survey covering an extended period has been found (source 20). Overall averages of all the data have been calculated: they are not inconsistent with the mean values from source 20.

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HAKES

Merluccius spp 1,48(05)004,xx

All species of Merluccius are similar and are considered together. Species coming within the scope of this review are:

CAPE HAKES

Merluccius capensis, *M. paradoxus* 1,48(05)004,xx

EUROPEAN HAKE

M. merluccius 1,48(05)004,01

SILVER HAKE

M. bilinearis 1,48(05)004,04

CHILEAN HAKE

M. gayi 1,48(05)004,05

ARGENTINE HAKE

M. hubbsi 1,48(05)004,06

NORTH PACIFIC HAKE

M. productus 1,48(05)004,07

Data from other species are also collected below; the selected values should be appropriate for all Merluccius species.

Yield

Fillet	Edible Flesh	Comments	Source
44.2		*Merluccius capensis*, *M. paradoxus*: South Africa: mean of 234 fish caught throughout year	1
41.8		*M. capensis*)	
		) South Africa	2
42.5		*M. paradoxus*)	
38.0	51.7	*M. capensis*: edible flesh yield by deboning machine	31
25.0		*M. capensis*: southwest Africa	34
50.6		*M. merluccius*: UK: 44 fish caught over 11 months: based on gutted, head on weight	6
64.0		*M. merluccius*: UK: mean of 2 fish: based on gutted head-on weight	9
50.0		*M. merluccius*: UK: based on gutted, head-on weight	10
61.5		*M. merluccius*: Atlantic: mean of 4 fish: based on headed and gutted weight	11

Fillet	Edible Flesh	Comments	Source
	86.5	M. merluccius: recovered by deboning machine: based on headed and gutted weight	12
44.0		M. senegalensis: north west Africa	15
	45.4	M. bilinearis: USA: recovered by deboning machine	16
33.6		M. bilinearis: USA: mean of 30 fish of 3 different sizes	17
	62.3	M. bilinearis: north and north west Atlantic	18
	78.6	M. bilinearis: USA: recovered by deboning machine: based on headed and gutted weight	19
	86.0	M. bilinearis: USA: recovered by deboning machine: based on headed and gutted weight	20
	65.0	M. bilinearis: USA: recovered by deboning machine: based on gutted, head-on weight	20
	59.0	M. bilinearis: includes skin	5
	47.5	M. gayi: Peru: excludes belly flaps	25
49.0		M. gayi: Chile: based on gutted, head-on weight	26
43.0		M. hubbsi: Uruguay: includes a few bones	28
45.1 44.1 40.9		M. hubbsi: Uruguay: three size groups	32
30.0	44.7	M. productus: USA: edible flesh by deboning machine	36
25.0		M. productus: USA	37
30.0) 27.7)		M. productus: USA: two grounds	38
	49.0	M. productus: USA: by deboning machine	39
47.8-57.7		M. productus: probably includes skin	5
36.9		M. australis: New Zealand: mean of 6 fish	44

Selected values

Skinless fillets 41%
Edible flesh 53%

Values of fillet yield are very variable. After correcting data to a whole fish basis using additional data from sources 5, 28, 43 and 45 and correcting for the presence of skin by multiplying by 0.95, the range of values is from 25% to 52.5%. There is no evidence of a species variation. To arrive at the selected value, extreme values (over 45 or under 30) were omitted and the mean of the remainder taken.

Similarly, in the case of the total edible flesh figures,corrected to a whole fish basis, values over 60 or under 45 were excluded and the remainder averaged.

Composition

Protein	Fat	Comments	Source
16.2–20.6 mean 18.0	0.3–4.8 mean 1.6	M. capensis, M. paradoxus: South Africa: 253 (or 214) samples caught throughout year	1
17.8 17.7	1.13 1.64	M. capensis:) South Africa: M. paradoxus:) caught on several occasions	2
15.16–18.52 mean 16.89	0–1.77 mean 0.79	M. capensis: South Africa: 65 fish caught monthly	3
16.3	0.9	M. capensis: west Africa	4
17.0	1.4	M. capensis: southwest Africa	35
17.8	0.7	M. capensis:	5
17.6–19.7 mean 18.5	1.50–3.80 mean 2.24	M. merluccius: UK: 44 fish caught over 11 months	6
15.8–20.5 mean 17.9		M. merluccius: UK: 183 fish caught throughout year	7
18.82	0.62	M. merluccius: north Africa: means of 20 fish: probably includes skin	8
17.8–18.6	0.4–1.0	M. merluccius: UK	9
18.9	0.93	M. merluccius: Atlantic: means of 4 fish: protein by difference	11
17.5	0.9	M. merluccius	5
17.25 13.69	0.38) 0.36)	M. merluccius: Spain; 2 fish	13
16.50	2.63	M. merluccius; Italy	14
16.57	1.07	M. senegalensis: north west Africa	15

Protein	Fat	Comments	Source
17.22	1.08	M. senegalensis: north Africa: means of 18 fish: probably includes skin	8
16.2	1.48	M. bilinearis: USA: means of 30 fish of 3 different sizes	17
16.7	2.6	M. bilinearis: north and north west Atlantic	18
15.6-17.9 mean 16.7	1.1-4.1 mean 2.7	M. bilinearis: USA: may include skin	5
16.68	1.35	M. bilinearis: USA: means of 6 fish	21
15.1	1.37	M. bilinearis: USA: protein by difference	22
15.78	1.67	M. bilinearis: USA	23
16.2	1.41	M. bilinearis: USA: means of single batch of 14 fish	24
16.3-19.5 mean 17.8	0.78-4.76 mean 2.43	M. bilinearis: USA: 20 or 25 fish	40
16.3	0.5	M. gayi: Peru	25
14.2-17.4	0.6-1.3	M. gayi: Chile	27
15.89	0.34	M. gayi	30
16.4	1.8	M. hubbsi: Uruguay: means of 2 batches	33
16.42	1.40	M. hubbsi	29
17.1	1.2	M. hubbsi	34
16.4	1.8	M. hubbsi: Uruguay	30
17.8	1.1	M. hubbsi: means of 5 samples	43
16.2-22.4 mean 18.4	0.20-1.50 mean 0.69	M. productus: USA: 17 or 18 fish	40
14.0-18.7 mean 16.3	0.5-3.8 mean 2.0	M. productus: USA	38
15.7	1.44	M. productus: USA: means of 18 fish	41
16.2	1.30	M. productus: USA: 1 fish	42
15.0-17.4 mean 16.4	0.9-2.8 mean 1.6	M. australis: New Zealand: means of 6 fish	44

Selected values

Protein 17.8%
Fat 2.5%

There are 4 sets of data that cover most of the year, from sources 1, 3, 6 and 7. The means of these have been selected and are consistent with all the other data.

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INDIAN MACKERELS

Rastrelliger spp 1,75(01)014,xx

This monograph derives selected data for 2 items within the scope of the study:

INDIAN MACKERELS NEI

Rastrelliger spp 1,75(01)014,xx

INDIAN MACKEREL

Rastrelliger kanagurta 1,75(01)014,03

Yield

Fillet	Edible Flesh	Comments	Source
	65.74	Rastrelliger brachysoma: Philippines	1
	52.0	R. brachysoma: Philippines	2
	61.6	R. kanagurta: India	4
45.9-49.5		R. kanagurta: fillets with skin	12
	58.78	R. chrysozonus: Philippines	1
	44.9	R. chrysozonus: Philippines	2

Selected values

Skinless fillets [45%]
Edible flesh 57%

The only available data for fillet yield have been corrected for the presence of skin to give the selected value. The value for total flesh is the mean of the 5 values listed.

Composition

Protein	Fat	Comments	Source
20.88	0.92	Rastrelliger brachysoma: Philippines	1
20.84	0.65	R. brachysoma: Philippines	2
20.7	6.5	R. neglectus (= brachysoma): Thailand: single lot	3
18.92	1.69	R. kanagurta: India	4
19.66-25.22 mean 22.03	2.58-5.32 mean 3.78	R. kanagurta: Seychelles: means of 38 fish from single lot	5
20.79-24.57 mean 22.03	1.48-2.71 mean 2.08	R. kanagurta: Malaysia: means of 7 or 8 fish	6

Protein	Fat	Comments	Source
	6.0	R. kanagurta: India	7
21.21	7.51	R. kanagurta: India	8
	0.97-6.30 mean 3.95	R. kanagurta: India: sampled monthly over 18 months	9
18.27-22.99 mean 20.95	0.63-8.50 mean 3.29	R. kanagurta: India: sampled 60 times over 3 years	10
21.8	2.3	R. kanagurta: 5 batches from different grounds and times	12
20.5	0.7	R. kanagurta: Indian ocean: 1 fish	11
16.93	0.92	R. chrysozonus: Philippines	1
17.19	4.07	R. chrysozonus: Philippines	2

Selected values

Protein 20.4%
Fat 3.2%

The selected values are the means of all the collected data. They are in good agreement with the results of the only complete survey of composition (source 10).

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JACK AND HORSE MACKERELS

Trachurus spp 1,70(23)004,xx

All Trachurus species are considered together, since adequate data are not available for some species.

The following species and group, falling within the scope of this study, are included here:

JACK AND HORSE MACKERELS NEI

Trachurus spp 1,70(23)004,xx

ATLANTIC HORSE MACKEREL

Trachurus trachurus 1,70(23)004,01

JAPANESE JACK MACKEREL

Trachurus japonicus 1,70(23)004,03

CHILEAN JACK MACKEREL

Trachurus murphyi 1,70(23)004,05

MEDITERRANEAN HORSE MACKEREL

Trachurus mediterraneus 1,70(23)004,08

CAPE HORSE MACKEREL

Trachurus capensis 1,70(23)004,13

CUNENE HORSE MACKEREL

Trachurus trecae 1,70(23)004,14

Some data for T. trachurus from Southern Africa is allocated to T. capensis.

Yield

Fillet	Edible Flesh	Comments	Source
	59.50-80.68 mean 71.35	T. trachurus: Spain: mean of 51 fish over 9 month period: probably includes skin and bones	1
	49-54	T. trachurus: UK: recovered by deboning machine	2
	60	T. trachurus: Portugal: may include skin	3
	46-52	T. trachurus: meat without skin	4
	81.1	T. trachurus: yield from headed, gutted fish	5
52.0-57.5		T. japonicus: probably skin-on	4
	53 8-60.5	T. japonicus: N Pacific: flesh and skin	8
	55.3	T. symmetricus murphyi: south east Pacific: flesh with skin: mean of 9 fish	13

Fillet	Edible Flesh	Comments	Source
	53.5	T. symmetricus murphyi: Peru: without skin	14
	56.4-61.9	T. symmetricus: skin-on	8
	42.1-62.5 mean 49.9	T. capensis: skin-on	4
45.6		T. declivis: New Zealand: 8 fish caught at same time	20

Selected values

Skinless fillets [46%]
Edible flesh 52%

The value for fillet yield from source 4 seems rather high. The value from source 20 has therefore been taken but, as it relates to a less common species, the value has been put in brackets.

The only reasonable seasonal survey of total yield is from source 1, but the yield includes skin and bones. The other data include values both with and without skin. When a 5% correction is made for skin, the two sets of data are quite concordant and their overall mean is taken.

Composition

Protein	Fat	Comments	Source
15.06-20.21 mean 17.55	0.49-10.98 mean 4.05	T. trachurus: Spain: mean of 51 fish over 9 month period: probably includes skin and bones	1
17-19	2.1-20.4 mean 8.47	T. trachurus: UK: caught over several years	2
20.5	1.8	T. trachurus: Portugal: may include skin	3
17.6-21.7 mean 19.0	1.3-13.6 mean 5.5	T. trachurus: several fishing grounds	4
	8.2	T. trachurus: mean of 18 fish caught at same time	6
	1.3-9.0 mean 4.7	T. trachurus: Spain: caught over 9 months	7
18.1	4.2	T. trachurus: W. Africa: 4 fish	12
	1.1-23.0 mean 5.82	T. trachurus: Atlantic: monthly samples over 2 years	19

Protein	Fat	Comments	Source
18.6-22.0	1.0-10.0	T. japonicus	4
18.6-24.2 mean 20.5	0.6-10.0 mean 4.5	T. japonicus: N. Pacific: November to May	8.
	1.1-11.2 mean 3.8	T. japonicus: Japan: sampled 14 times over 1.5 years	9
	2.9 Autumn 3.4 Winter 12.8 Spring 9.2 Summer	T. japonicus Japan: 4 batches	10
20.9	7.71	T. japonicus: Japan: 3 fish	11
	4.6	T. symmetricus murphyi: south east Pacific	13
19.9	3.1	T. symmetricus murphyi: Peru	14
20.3-22.5	3.7-4.6	T. symmetricus	8
21.56	5.62	T. symmetricus: east coast USA: single fish	15
17.4-21.1 mean 19.7	0.1-8.7 mean 3.3	T. trachurus (= capensis): South Africa: 20 fish	16
20.2	2.4	T. trachurus (= capensis): South Africa: 2 fish	17
19.7	3.9	T. capensis	4
19.65	1.52	T. trachurus (= capensis): South Africa: 6 fish caught at same time	18
22.0	6.0	T. declivis: New Zealand: 8 fish caught at same time	20
20.48	6.32	T. declivis and T. novaezelandiae: mean of 6 batches caught over whole year (121 fish)	21

Selected values

Protein 19.7%
Fat 5.8%

The data from source 1 cannot be used as they appear to refer to fish that include skin and bones. Other sources that cover an extended period of time (sources 2, 7, 8 (T. japonicus only), 9, 10, 19 and 21) have been averaged to give the selected values.

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JACKS, CREVALLES, NEI

Caranx spp 1,70(23)044,xx

Yield

Fillet	Edible Flesh	Comments	Source
32.6		Caranx georgianus: skinless	1
	55.1	C. hippos: includes skin	2
	55.5	C. kalla	3
	65.74	C. kalla	4
	58.0	C. melampygus	5
	53.5	C. sexfasciatus	3
	66.27	C. sexfasciatus	4
	57.3	C. sp	6
	38.4 56.7	C. sp	3
	52.96	C. sp	7

Selected values

Skinless fillets [33%]
Edible flesh 56%

The tentative value for fillet yield is that of source 1. The value for total edible flesh is the mean of all the data (after correcting source 2 data for skin). The very low value of 38.4 for an unidentified species in source 3 has been included in the calculation of the mean, as there is no good reason for excluding it.

Composition

Protein	Fat	Comments	Source
20.75	1.17	Caranx chrysus (= crysos?): means of 8 fish	8
19.8	0.2	C. chrysos (= crysos?)	9
19.8	0.2	C. crysos	13
20.4	2.7	C. georgianus: means of 6 fish	1

Protein	Fat	Comments	Source
18.5	2.7	C. carangus	10
16.65	0.35	C. djedaba	3
21.3	1.5	C. ignobilis	13
19.35	1.03	C. kalla	3
19.16	1.67	C. kalla	4
	2.2	C. kalla	11
19.62	2.71	C. kalla	12
20.43	2.13	C. malabaricus	14
21.20	1.55	C. melampygus	5
20.7	0.9	C. melampygus	13
	0.69	C. mertensi	15
	0.985	C. rottleri	16
19.58	6.09	C. sexfasciatus	3
20.89	0.43	C. sexfasciatus	4
18.24	0.50	C. sp	3
19.31	3.97	C. sp	3
21.0		C. sp	6
20.18	2.17	C. sp	7
19.2-22.8 mean 20.7	0.4-4.1 mean 1.6	C. spp: different grounds and seasons	17

Selected values

Protein [19.9%]
Fat [1.7%]

No survey of any species has been found. The tentative values proposed are the means of all the data.

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JAPANESE PILCHARD

Sardinops melanosticta 1,21(05)013,01

CALIFORNIA PILCHARD

Sardinops caerulea 1,21(05)013,02

SOUTH AMERICAN (CHILEAN) PILCHARD

Sardinops sagax 1,21(05)013,03

SOUTHERN AFRICAN PILCHARD

Sardinops ocellata 1,21(05)013,05

All four species are similar; in the past they have all been considered subspecies of S. sagax, and will be considered together.

Yield

Fillet	Edible Flesh	Comments	Source
	53.3	S. sagax	1
43-48) 53-56)		S. melanosticta: probably skin-on: two regions, different seasons	2
	50.7	probably S. melanosticta: mean of ranges of three lots	3
	58.0	S. melanosticta	4
	51.4	S. caerulea: 20 fish: value estimated by subtracting weights of bones, skin and fins from body weight	5

Selected values

Skinless fillets 50%
Edible flesh 53%

Values are based on simple averages of the data. The value for skinless fillets is of little relevance as small fish are not normally filleted commercially, but are eaten as whole, canned (headed and gutted) dried, salted or smoked fish.

Composition

Protein	Fat	Comments	Source
20.5	7.0	S. sagax	1
	1.25-8.75	S. sagax: mean not given: sampled monthly over two years	6

Protein	Fat	Comments	Source
20-23) 16-17)	2.5-12) 26-32)	S. melanosticta: two regions, different seasons	2
18-20		S. melanosticta	5
	14.45-28.17) mean 21.87)	S. melanosticta: 52 fish from single catch	7
	3.9-10.7) mean 7.02)	S. melanosticta: mean of 135 fish: sampled on 11 occasions within 7 successive months	8
18.81	11.76	S. caerulea: means of 95 fish: sampled on 12 occasions within 7 successive months	9
17.5-21.7	0.3-0.8	S. caerulea	5
18.6-21.4	4.2-10.3	S. ocellata	5
17.5-21.7	0.3-1.4	S. neopilchardus	5

Selected values

Protein 18.9%
Fat 7.9%

Protein figure is mean of results from sources 2 and 9. (Source 1 was probably a single sample). Fat is mean of data from 6, 8 and 9, the only surveys that cover an extended period of the year. The higher figures from sources 2 and 7 suggest that there may be a geographical as well as a seasonal variation. The selected value is consistent with the results of a 5 year survey of the fat content of whole Southern African pilchards (source 10).

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JELLYFISHES

Rhopilema spp 6,17(41)007,xx

Little information is readily available on the mode of utilization of jellyfishes. No data has been collected on the edible yield. Only one analysis (1) has been found: protein content was 0.8% and fat content 0.1%. It would appear that the contribution to the protein and fat intake of any country from jellyfish would be insignificant.

Source

1. Moodie, I.M., Burger, J. and Heydenrych, C. Composition of jellyfish. Annual Report, Fishing Industry Research Institute 34 50 (1980)

MILKFISH

Chanos chanos 1,22(02)001,01

Yield

Fillet	Edible Flesh	Comments	Source
	60.7	Philippines: pond-raised: 240 fish between 100 and 1200 g studied	1
	67.10	large)	
	61.64	medium): Philippines	2
	70.56	Philippines: may include skin	3
	68.4	Philippines: may include skin	4
	67.5	Philippines: may include skin	5

Selected values

Skinless fillets [46%]
Edible flesh 61%

The figure for edible flesh is from the extensive data of source 1; it is consistent with the remaining data. The provisional figure for fillet yield is the figure for Atlantic herring, chosen on the slender grounds that milkfish is sometimes described as "resembling herring".

Composition

Protein	Fat	Comments	Source
20.57	5.28	large)	
20.73	5.67	medium) : Philippines	2
19.24	5.57	Philippines	3
20.53	6.16	Philippines	4
21.4	3.46	Philippines	5
	3.5	India: mean of 12 fish	6
24.06	3.51	India	7

Selected values

Protein	21.1%
Fat	4.7%

The selected values are means of all the data: no surveys are available.

Sources

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MULLETS NEI

Mugilidae 1,65(01)xxx,xx

and

FLATHEAD MULLET

Mugil cephalus 1,65(01)001,02

Yield

Fillet	Edible Flesh	Comments	Source
	48.7	Mugil cephalus: Mediterranean: probably includes skin and bones	1
	55.6	M. cephalus: Philippines: probably includes skin	2
31.8		M. cephalus: Atlantic: mean of 11 fish	3
	68.5	M. cephalus: Spain: may include skin and bones	4
41.7		M. cephalus: north west Africa: skinless	5
28.7		M. cephalus: New Zealand: skinless: mean of 6 fish	6
	73.5	M. oeur: India: may include skin and bones	7
	56.4-61	M.so-iuy: Pacific: includes skin	8
	44.5	M. sp: Philippines	9
	48	Mugil (= Liza) vaigiensis: Philippines	10
	70	Mugil (= Valamugil) speigleri: India: may include skin and bones	11

Selected values

Skinless fillets 34%
Edible flesh 50%

The skinless fillet figure is the mean of the collected results. The total flesh data that may include bones have been omitted, and the mean of the remainder taken, after correcting for skin where necessary by a 5% reduction.

Composition

Protein	Fat	Comments	Source
21.81	6.78	Mugil cephalus: Mediterranean: may include skin and bone	1
18.4	4.3	M. cephalus: Philippines: probably includes skin	2
18.6	1.1	M. cephalus: Atlantic: means of 11 fish	3
17.88	3.04	M. cephalus: Spain	4
21.15	0.98	M. cephalus: north west Africa	5
21.6	3.4	M. cephalus: New Zealand: means of 6 fish	6
18.9	12.5	M. cephalus: Australia: means of 3 batches	12
20.84	5.06	M. cephalus: India	13
	3.54	M. cephalus: Japan: mean of 2 fish	14
17.80	1.24	M. cephalus: Spain: single fish	15
	4.5	M. cephalus: east USA: sampled over 10 months of year in 4 locations: mean of 20 batches	16
	5.06	M. cephalus: India: mean of 10 fish	17
20.3	1.70	M. cephalus: Japan	18
20.0	0.7	M. cephalus: west Africa	19
19.3	6.1	M. cephalus: Pacific: means of 3 grounds	8
19.06	7.83	M. oeur: India	7
20.22	2.45	M. oeur: India	20
	3.0	M. passia: India	21
19.6	9.8	M. so-iuy: Pacific: means of 3 grounds and several catching times	8
20.4	4.8	M. sp: east USA	22
20.68	4.23	M. sp: Philippines	9
20.41	2.55	Mugil (= Liza) vaigiensis: Philippines	23
20.82	2.62	Mugil (= Liza) vaigiensis: Philippines	10
19.01-22.90 mean 21.20	0.20-10.29 mean 5.28	Mugil (= Liza) capito: South Africa	24

Protein	Fat	Comments	Source
17.83		Mugil (= Valamugil) speigleri: India	11
	0.515	Mugil (= Valamugil) speigleri: India	25
	0.806	Mugil (= Valamugil) speigleri: Pakistan	26

Selected values

Protein 19.8%
Fat 4.0%

Only one good survey, of fat only, has been found (Source 16). There seems to be no significant differences among species and related genera and so the selected values are means of all the data. The mean fat content agrees well with the single survey result.

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NILE PERCH

Lates niloticus **1,70(01)167,07**

No data on yield or composition of Nile perch have been found. Limited data on the related species, Centropomus undecimalis, are given below.

Yield

Fillet	Comments	Source
57	Centropomus undecimalis	1

Selected values

Skinless fillet [57%]
Edible flesh [65%]

The value for edible flesh is a likely maximum: no closely comparable species is included in the present survey.

Composition

Protein	Fat	Comments	Source
21.2	0.83	Centropomus undecimalis	1

Selected values

Protein [21.2%]
Fat [0.8%]

Source

1. Tucker, J.W., Landau, M.P. and Faulkner, B.E. Culinary value and composition of wild and captive common snook, Centropomus undecimalis. Florida Sci. 48 196-200 (1985)

NORTHERN PRAWN

Pandalus borealis 2,28(04)002,03

Yield

Edible Flesh	Comments	Source
36.2	Pandalus borealis: raw, iced, washed	2
33.0	P. borealis: cooked	2

Selected value

Meat [36%]

Only one measurement of yield of raw meat has been collected.

Composition

Protein	Fat	Comments	Source
15.2	-	Pandalus borealis: raw, iced, washed	1
13.5-20.2 mean 17.1	0.12-0.82 mean 0.39	P. borealis: raw: means of 19 or 23 batches	3
18.1	0.95	P. borealis: raw: means of 5 batches	4
	1.32	P. borealis: raw: mean of 8 batches	5
	1.2-1.5	P. borealis: raw	6
18.8	1.55	P. jordani: cooked	7

Selected values

Protein 16.8%
Fat 1.0%

The selected values are means of all "raw" data.

Sources

1. Bullard, F.A. and Collins, J. Physical and chemical changes of pink shrimp, Pandalus borealis, held in carbon dioxide modified refrigerated seawater compared with pink shrimp held in ice. Fishery Bull. 76 73-78 (1978)

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PACIFIC COD

Gadus macrocephalus 1,48(04)002,11

Yield

Fillet	Edible Flesh	Comments	Source
28.8		mean of 108 fish caught at various times	1
31.8		mean of 3 batches	2
	37.8	by deboning machine	3
28.0	40.4	flesh yield by deboning machine	4
	45.2		8

Selected values

Skinless fillets 30%
Edible flesh 41%

The available data, though limited, are self consistent: selected values are means of the data quoted. They are lower than the corresponding data for Gadus morhua, but this is at least consistent with the species name macrocephalus.

Composition

Protein	Fat	Comments	Source
15.8–19.1 mean 17.9	0.31–0.78 mean 0.62	means of 108 fish	1
	0.58	mean of 10 fillets	5
17.1	0.78	means of 33 fish from same source	6
17.1	0.9		7
17.0	0.4	means of several grounds and seasons	8

Selected values

Protein 17.3%
Fat 0.7%

The data available are again, surprisingly, limited but consistent. Selected values are means of the data quoted. They are close to the figures selected for Gadus morhua.

Sources

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PACIFIC CUPPED OYSTER

Crassostrea gigas 3,16(07)008,01

Also included here are:

AMERICAN CUPPED OYSTER

Crassostrea virginica 3,16(07)008,03

CUPPED OYSTERS NEI

Crassostrea spp 3,16(07)008,xx

Data from other Crassostrea and Ostrea species are included in the assessment. These allow a separate yield to be estimated for Ostrea spp, although Ostrea spp do not come within the scope of this survey.

Yield

Oysters, especially Crassostrea, are commonly found in estuaries where the salinity of the water may vary. The meat of the oyster readily alters its water content in response to such variation. For this reason, many of the measurements of yield in the literature are based on the dry weights of the meats and in the absence of data on water content, cannot be taken into account. As the entire contents of the oyster are eaten, only one yield figure is appropriate. Some variability in the available data is to be expected because of the water content variability, and also because the liquor within the shell may sometimes be included in the edible portion. It is seldom clear whether this is so: data that definitely do include the liquor have been excluded.

Edible Flesh	Comments	Source
11.8	Crassostrea virginica: America: sampled twice only	1
9.2	C. virginica: Canada: mean of two lots	2
9.94	C. angulata: Spain: 333 specimens harvested on 28 occasions throughout year	3
9.20	Ostrea virginiana (= Crassostrea sp): India: sampled 28 times over complete year	4
11.29	O. edulis: Canada: mean of 2 lots	2
8.22-16.19 mean 11.81	O. edulis: England: 4 grounds sampled over complete year	5
11-17	O. edulis: UK	6
18	O. orientalis: Philippines	7
15	O. laperousei: Japan: mean of three samples at different times	8
15.00	O. cucullata: India	9

Selected values

Edible flesh

Crassostrea spp	10%
Ostrea	14%

The yields for Crassostrea species tend to be lower than those for Ostrea. The two Crassostrea surveys covering a whole year (sources 3 and 4) have been averaged to give the selected value. As there is only one survey of an Ostrea species over a year (source 5), all the figures have been averaged.

Composition

Oysters, like many molluscs, contain significant amounts of glycogen. In most of the sources below glycogen is determined directly. In a very few cases the figure for glycogen is for total carbohydrate by analysis or by difference.

Protein	Fat	Glycogen	Comments	Source
	2.5		Crassostrea gigas: mean of 12 specimens caught at same time	10
11.5	2.2	1.7	C. gigas: Korea: means of values in 8 months of year	11
4.48-10.48 mean 6.82	0.56-1.97 mean 1.10		C. virginica: USA: means of 40 fish	12
8.59	2.36		C. virginica: USA: means of 2 batches	1
5.7	1.1	3.1	C. virginica: USA: means over two years and 6 grounds	13
	1.1	1.8	C. virginica: Canada: single batch	14
5.8-10.4 mean 7.15	1.4-3.0 mean 2.3	0.47-6.92 mean 2.36	C. virginica: USA: means over full year from 2 grounds	15
11.28	11.67	2.62	C. angulata: Spain: 28 samples over complete year	3
5.72-13.31 mean 9.79	1.01-3.07 mean 2.04	0.46-5.85 mean 2.65	Ostrea virginiana (= Crassostrea sp): India: sampled over whole year	4
10.51	1.92	6.27	O. edulis: England: 4 grounds sampled over whole year or most of year	5
6.5	3.2	3.2	O. orientalis: Philippines	7
9.41	0.74	3.60	O. laperousei: Japan: 3 samples at different times of year	8
25.0	1.68	0.84	O. cucullata: India: single sample	9

Protein	Fat	Glycogen	Comments	Source
8.1	1.3	5.7	O. taurica: Black Sea: sampled over 7 months	16
8.40	1.96	3.56	species not stated: Japan: sampled over whole year	17

Four sets of data, from sources 3, 4, 13 and 14, cover analyses of Crassostrea spp over the complete year. Within these 4 sets there are big variations in mean content of protein, from 5.7 to 11.5%. There are, however, no grounds for excluding any data, or for estimating values for separate species. The selected values are therefore the means of the 4 sets of data.

There is only one set of data over a complete year, from source 5, for Ostrea spp: in this work glycogen is actually carbohydrate by difference and so subject to a degree of doubt. Apart from the protein content in source 9, which must be considered doubtful, the Ostrea data are consistent with the selected Crassostrea values.

Selected values (for Crassostrea spp: probably suitable also for Ostrea spp)

Protein 8.5%
Fat 1.8%
Glycogen 2.7%

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PACIFIC HERRING

Clupea pallasi 1,21(05)001,07

Yield

Fillet	Edible Flesh	Comments	Source
	66.6	by deboning machine	1
	64–77	includes skin and bones	2
50–60		fillets with skin	3
	41.6–65.4	flesh without skin	4

Selected values

Skinless fillets [52%]
Edible flesh 60%

The data are very limited. The fillet value is the mean figure from source 3, reduced by 5% to take account of skin. The edible flesh value is the mean of data from sources 1 and 4.

Composition

Protein	Fat	Comments	Source
16.8 17.8	5.5 19.0	"spring" : Apr.–May) "feeding": June–Oct.) Sakhalin	5
18.7 18.2	6.3 12.0	"spring" : Nov.–June) "oily" : various times) Japan and adjacent sea and grounds)	6
	12.0	Apr.–Aug.: Kamchatka: 7 batches	7
	12.9	Aug.–Sept.: Sea of Okhotsk: 9 batches	8
15.3–18.6 mean 17.0	1.2–20.6 mean 13.5	Mar.–Nov.: Vladivostok	4
	11.1	May–Aug.: several grounds	4
16.2–20.4 mean 18.1	1.0–25.7 mean 12.0	Apr.–Nov.: Sakhalin: 7 batches	4
	4.5–25.1 mean 11.6	early May–early Oct.: Sea of Okhotsk	4
16.7	2.6	2 batches, total of 20 fish	9
16.0	12.5	USA: 2 batches, total of 14 fish	10
15–9	2–35		2

Selected values

Protein 17.8%
Fat 11.6%

The data include several surveys of fish caught over the commercial catching period. All surveys, from sources, 4, 5, 6, 7 and 8, are averaged to give the selected values.

Sources

1. Miyauchi, D. and Steinberg, M. Machine separation of edible flesh from fish. Fishery Ind. Res. 6 165-171 (1970)

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PACIFIC SALMON

Oncorhynchus spp 1,23(01)009,xx

The following Oncorhynchus species come within the scope of this study:

PINK (HUMPBACK) SALMON

O. gorbuscha 1,23(01)009,02

CHUM (KETA, DOG) SALMON

O. keta 1,23(01)009,03

SOCKEYE (RED) SALMON

O. nerka 1,23(01)009,06

COHO (SILVER) SALMON

O. kisutch 1,23(01)009,08

Data on all Oncorhynchus species have been collected below; the selected values should be applicable to all species.

Yield

Fillet	Edible Flesh	Comments	Source
	66.4	O. gorbuscha: USSR	1
	53.4-61.3	O. gorbuscha: USSR	2
50		O. gorbuscha: USSR	3
	61.6-68.7	O. keta: USSR	2
	57.6-62.6	O. nerka: USSR	2
	69.4	O. nerka: includes skin and bone: Canada	4
	56.7	O. nerka: Canada	5
	58.6-64.8	O. tshawytscha: USSR	2

Selected values

Skinless fillets [50%]
Edible flesh 62%

The selected value for skinless fillets is the only figure found in the literature. The edible flesh value is a simple mean of the collected results.

Composition

Protein	Fat	Comments	Source
17.0-22.0 mean 19.5	1.7-9.1 mean 3.6	O. gorbuscha: Alaska	6
19.1-21.5 mean 20.6	2.0-7.9 mean 3.7	O. gorbuscha: west USA	7
	7.8	O. gorbuscha: White Sea: mean of male and female	1
15.2-23.2 mean 19.0	7.4-12.1 mean 4.76	O. gorbuscha: USA: mean of 3 grounds	8
12.2-22.5 mean 19.4	1.9-12.0 mean 6.3	O. gorbuscha: USSR: means of different grounds, July to September	2
19-24	4-9	O. gorbuscha	3
20.12 15.95	8.45 1.58	Summer) O. keta: Japan: means of Autumn) 12 fish: dorsal muscle	9
19.2	2.9	O. keta: Japan: means of 18 fish during migration: dorsal muscle	10
22.10	5.98	O. keta: Japan: means of 18 fish: means of dorsal and abdominal muscle	11
21.8	2.8	O. keta: Japan: means of 2 fish	12
	12.4	O. keta: Japan: mean of 3 fish	13
20.2-23.3 mean 21.3	2.18-7.33 mean 3.86	O. keta: USA: means of 7 fish	8
17.2-23.3 mean 20.8	3.1-15.5 mean 7.2	O. keta: USSR: several grounds and periods	2
19-23	4-9	O.keta: USSR	3
20.5	8.9	O. masou: USSR: 2 grounds	2
18.2	13.6	O. masou: USSR	3
21.96	9.94	O. nerka: Canada: 8 lots, total of 56 fish	14
18.6		O. nerka: Canada: 1 fish	15
22.0	9.6	O. nerka: USA	16
19.8	7.79	O. nerka: USA: composite sample of 12 fish	17
	7.1	O. nerka: Japan: 1 fish	18

Protein	Fat	Comments	Source
17.2-23.4 mean 21.3	1.26-13.7 mean 8.55	O. nerka: USA: means of 42 fish	8
13.7-22.9 mean 20.6	2.1-11.4 mean 6.6	O. nerka: USSR: several grounds and periods	2
19-22		O. nerka: USSR	3
19.6	12.9	O. tshawytscha: USSR: 2 lots	2
	10-13	O. tshawytscha: USSR	3
19.5	11.5	O. tschawytscha: USA: 3 fish	8
19.13	11.82	O. tshawytscha: USA: 1 fish	19
16.97	16.43	O. tshawytscha: USA	20
20.0-22.8 mean 21.5	1.63-12.51 mean 5.73	O. kisutch: USA: means of 9 lots, total 90 fish: caught June to October in three successive years	21
21.2	9.9	O. kisutch: USSR: means of 3 lots	2
20-23	6-9	O. kisutch: USSR	3

Selected values

Protein 20.5%
Fat 6.3%

The collected data include a number of good surveys of composition of fish during the commercial fishing season. The selected values are the means of 9 such surveys: for O. gorbuscha, sources 2, 6, 7 and 8; for O. keta, source 2; for O. nerka, sources 2, 8 and 14; for O. kisutch, source 21.

The much less extensive data for O. masou and O. tshawytscha appear to suggest that these species have a rather higher fat content than the major species, but this cannot be considered certain.

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PACIFIC SAURY

Cololabis saira

1,47(02)007,01

Yield

Fillet	Edible Flesh	Comments	Source
54-61		may include skin	1
	71.7	weighted mean of 3 sizes	2
	64.0	sum of light and dark meats	3
	59.6-65.2	includes skin	4

Selected values

Skinless fillets [52%]
Edible flesh 64%

Composition

Protein	Fat	Comments	Source
19-23	11.5	value for fat is mean over some grounds, seasons and sizes	1
19.91	13.04	weighted means of 3 size groups	2
	9.98	weighted mean of 3 size groups: caught year after previous entry	5
21.6	12.0	weighted means of values for light and dark meats	3
21.5	9.8	means of some grounds and seasons	4
	6.0	mean of 189 samples over 10 months	6
	4.38	mean of 5 samples	7
23.5	5.8	Scomberesox saurus: protein is mean of 3, fat of 8 batches	8
23.2	5.2	S. saurus	1

Selected values

Protein 21.8%
Fat 8.6%

No satisfactory surveys are available. Selected values are means of all data.

Sources

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2. Tsuchiya, Y. et al. Biochemical studies on skipper (Cololabis saira)-I. General component. Bull. Jap. Soc. Sci. Fish. 19 513-517 (1953)

3. Miwa, K., Sato, Y. and Kinoshita, E. Studies on the utilization of migratory fish - II. On the constituent parts of body of saury and their chemical components. Bull. Hokkaido Reg. Fish. Res. Lab. 19 66-71 (1958)

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PENAEUS SHRIMPS NEI

Penaeus spp 2,28(01)001,xx

NORTHERN BROWN SHRIMP

Penaeus aztecus 2,28(01)001,01

BANANA PRAWN

Penaeus merguiensis 2,28(01)001,03

NORTHERN WHITE SHRIMP

Penaeus setiferus 2,28(01)001,22

Data have been collected on Penaeus shrimps, but not on related genera such as Metapenaeus and Parapenaeus. Source 1 has been used as an authoritative guide to the allocation of species to particular genera.

Yield

Edible Flesh	Comments	Source
42.2	Penaeus duorarum: Nigeria	2
46.7-51.9	P. japonicus: Japan	3
62.1	P. monodon: Philippines	4
70.0	P. carinatus (= P. monodon): India	5
49.4	P. indicus: India	6
55.0	P. indicus: India	5
62.5	P. indicus: Philippines	4
62.5	Penaeus spp: Philippines	7

Selected value

Edible flesh 57%

As far as can be determined all the yields quoted are for raw meats: results for cooked meat yield have been excluded. The selected value is the mean of all the data.

Composition

Protein	Fat	Comments	Source
21.4	0.14	P. aztecus: USA: means of 20 or 23 samples	8
19.17	2.29	P. aztecus: USA	9
	1.20	P. aztecus: USA	10
21.79	2.19	P. duorarum: USA	9
	0.8	P. japonicus: Japan	3
22.85	1.66	P. carinatus (= monodon): India	5
20.76	0.67	P. monodon: Philippines	4
20.6	0.20	P. setiferus: Gulf of Mexico	8
22.0	0.17	P. setiferus: S. Atlantic	8
19.3		P. setiferus: USA	11
18.27	4.49	P. setiferus: USA	9
20.90	0.35	P. indicus: India	12
17.13	0.41	P. indicus: Philippines	4
	1.0	P. indicus: India	13
19.67	1.47	P. indicus: India	5
21.5	1.7	P. penicillatus: India	14
20.32	0.86	P. schmitti: Venezuela	15
21.1	3.2	Penaeus spp: Philippines	7

Selected values

Protein 20.5%
Fat 1.3%

No seasonal study of composition has been found. The selected values are means of all the collected data which are for raw meats. There is no clear evidence of any species difference.

Sources

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2. Emokpae, A.O. Preliminary studies on the chemical and weight composition of some commercially important species of fish and shrimp caught in the Nigerian inshore waters. J. Fd Technol. 18 271-283 (1983)

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13. Gopakumar, K. and Nair, M.R. Lipid composition of five species of Indian prawns. J. Sci. Fd Agric. 26 319-325 (1975)

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PONYFISHES (=SLIPMOUTHS) NEI

Leiognathidae 1,70(35)xxx,xx

Yield

Fillet	Edible Flesh	Comments	Source
	95.0	Leiognathus bindus: eviscerated only	1
	94.0	Leiognathus insidiatrix (= Secutor insidiator?): eviscerated only	1
	44.04	L. equulus: skinless	2
	30.9	L. equulus	3
	40.0	L. rivulata: may include skin	4
	42.0	L. daurus (= daura): includes skin	5
	35.6	L. sp: by deboning machine	6
	25.3	L. sp.	7
	30.8	Leiognathidae: by deboning machine	9
	41.80	Leiognathidae	10

Selected values

Skinless fillets –
Edible flesh [36%]

Small fish like ponyfishes are unlikely to be filleted before cooking. No figure is available and there seems no need to derive a figure from analogy with other species. The selected value for total flesh is provisional, in the absence of any surveys: it is the mean of all data except those from Source 1.

Composition

Protein	Fat	Comments	Source
18.77	1.16	Leiognathus bindus: eviscerated only	1
19.17	1.55	Leiognathus insidiatrix (= Secutor insidiator?): eviscerated only	1
17.23	1.00	L. equulus	2
17.47	1.80	L. equulus	3
20.1	0.3	L. rivulata: may include skin	4

Protein	Fat	Comments	Source
19.6	1.5	L. daurus (= daura): includes skin	5
15.7	0.9	L. sp: by deboning machine	6
17.39	4.02	L. sp.: whole fish analysed	8
15.9	0.75	Leiognathidae: by deboning machine	9
19.23	0.54	Leiognathidae	10

Selected values

Protein [17.9%]
Fat [1.0%]

Selected values are means of all the data except those from Sources 1 and 8 which relate to whole, or nearly whole, fish.

Sources

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SAITHE

Pollachius virens 1,48(04)015,01

Yield

Fillet	Edible Flesh	Comments	Source
32.0		USA: mean of 3 sizes: 24 fish	1
46	55	UK: edible flesh by deboning machine: based on gutted, head-on weight	2
39	58	USA: edible flesh by deboning machine: based on gutted, head-on weight	3

Selected values

Skinless fillets 34%
Edible flesh 47%

The data based on gutted, head-on weight were converted to a whole fish basis by using a factor from source 4, and were then averaged to give the selected values.

Composition

Protein	Fat	Comments	Source
18.9	0.33	USA: 24 fish of three sizes	1
15.75–20.44 mean 18.36		UK: 95 fish caught over 8 months	5
15.88–20.75 mean 18.27		UK: 241 fish caught over complete year	6
16.4–20.3	0.3–0.6	UK: small number of fish	7
19.4	0.7	Norway: 34 fresh and a number of frozen fish analysed	8
17.95(±0.97)	0.91(±0.31)	±SD: 40 fish	9
19.0	0.4		10
17.35	0.29	Spain: 1 fish	11
16.4	0.3	UK: 1 fish	12

Selected values

Protein 18.3%
Fat [0.5%]

The two surveys, sources 5 and 6, are in good agreement and their mean is taken as the selected value for protein. Neither survey included fat: the fat figure is the mean of the available data.

Sources

1. Brooke, R.O., Ravesi, E.M. and Steinberg, M.A. The composition of commercially important fish taken from New England waters. II. Proximate analyses of butterfish, flounder, pollock, and hake, and their seasonal variation. J. Fd Sci. 27 73-76 (1962)

2. Ravichander, N. and Keay, J.N. The production and properties of minced fish from several commercially important species. Conference Proceedings: The production and utilization of mechanically recovered fish flesh (minced fish). ed. Keay, J.N. (Ministry of Agriculture, Fisheries and Food, UK, 1976) pp 18-24

3. King, F.J. and Carver, J.H. How to use nearly all the ocean's food. Oak Brook Seminar: Mechanical recovery and utilization of fish flesh. ed. Martin, R.E. (National Fisheries Institute, Washington, D.C. 1972) pp 222-238

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6. McLay, R., Howgate, P.F. and Morrison, J. Nitrogen content of seven British commercial species of fish. J. Assoc. Publ. Analysts 24 131-139 (1986)

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9. Lang, K. and Christen, U. The composition of the muscle meat of a number of sea fish of nutritional importance. Fleischwirtschaft 63 967-970 (1983)

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11. de las Heras, A.R. and Mendez Isla, M.C. Contribution to the chemical study of Spanish fish. Anales de Bromatologia 4 403-410 (1952)

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SARDINELLAS

Sardinella spp 1,21(05)012,xx

All sardinella species are considered together here, because of recent changes in nomenclature of species and because well over half the sardinellas caught are not allocated in FAO catch statistics to particular species.

The following species and group, falling within the scope of this study, are included here:

SARDINELLAS NEI

Sardinella spp 1,21(05)012,xx

GOLDSTRIPE SARDINELLA

S. gibbosa 1,21(05)012,03

INDIAN OIL SARDINE

S. longiceps 1,21(05)012,04

ROUND SARDINELLA

S. aurita 1,21(05)012,10

BALI SARDINELLA

S. lemura 1,21(05)012,23

Yield

Fillet	Edible Flesh	Comments	Source
50.8-54.7		S. jusseiu (= S. gibbosa): fillets with skin	1
	64.0	S. longiceps: Philippines: edible portion not defined	2
	60.0	S. longiceps: Philippines: probably includes skin	3
	70.0	S. longiceps: India: does not include skin or bones	4
	37.3	S. longiceps: India: separated from dressed fish by use of bone separator	5
	18.7	S. longiceps: India: separated from dressed fish by use of bone separator	6
	63.0	S. longiceps: body including skin and bones	1
	71.4	S. anchovia (= S. aurita): body including skin and bones	7
	43-64	S. aurita: does not include skin or bones	1

Fillet	Edible Flesh	Comments	Source
	61.0	S. fimbriata: Philippines: edible protein not defined	8
	76.16	S. fimbriata: Philippines: probably includes skin	3
	60.0	S. fimbriata: India: does not include skin or bone	4
	65.0	Clupea fimbriata (= S. fimbriata): India: mean over 7 months: does not include skin or bone	9
	57.9	S. fimbriata: includes skin	1
	46.6	S. perforata: Philippines: edible protein not defined	8

Selected values

Skinless fillets [53%]
Edible flesh 65%

Only one figure is available for fillets. The value from source 9 is chosen for edible flesh, as it is the only study which clearly covers an extended period of the year. The two values from sources 5 and 6 for mechanically recovered tissue are unrealistically low. When these figures, and those where the edible portion includes bone or is not defined, are excluded, the mean of the remaining data is 63%, in good agreement with the selected value.

Composition

Protein	Fat	Comments	Source
19.2	2.6	S. longiceps: Philippines: mean of at least 6 fish: edible portion not defined	2
17.73	4.61	S. longiceps: Philippines: sample of about 1 kg: edible portion not defined	8
21.01	1.89	S. longiceps: Philippines: probably includes skin	3
19.57	2.03	S. longiceps: India: flesh only	4
18.74	11.7	S. longiceps: India: recovered flesh	5
21.12 18.88	4.75 5.06	S. longiceps: India: 2 lots: flesh only	10

Protein	Fat	Comments	Source
21.09	10.30	S. longiceps: India: mean of 4 lots from single batch: flesh only	11
18.10	14.34	S. longiceps: India: probably an average value: possibly whole fish	12
19.0	7.0	S. longiceps: meat	1
	9.32	S. longiceps: India: average of 43 lots over complete year: whole fish	13
	10.83	S. longiceps: India: average over extended period: whole fish	14
17.0-22.3 mean 20.7	0.4-20.0 mean 3.7	S. aurita: Mediterranean: ranges and averages over three years: flesh with skin and bones	15
19.8	3.6	S. anchovia (= S. aurita): probably includes skin	7
21.2	1.24	S. aurita: Senegal: single sample: probably includes skin	16
22.40	1.31	S. aurita: South-east USA: caught over several months: skinless fillets	17
17.1-22.2	1.2-19.7	S. aurita: probably skinless	1
21.8	3.4	S. anchovia (= aurita)	1
19.91	2.28	S. fimbriata: Philippines: edible portion not defined	8
19.87	1.36	S. fimbriata: Philippines: probably includes skin	3
20.84	1.93	S. fimbriata: India: flesh only	4
18.57		Clupea (= S. fimbriata): India: flesh only	9
20.4	0.3	S. fimbriata: probably includes skin	1
22.7	1.6	S. eba	1
20.5 (±0.9)	4.8 (±2.1)	±SD: S. allecia: Brazil: sampled over whole year: whole fish	18
18.28	0.33	S. perforata: Philippines: edible protein not defined	8
20.7-23.1 mean 21.7	1.1-3.2 mean 1.9	S. sirm: Sri Lanka: sampled over 9 months: fish flesh (not defined)	19
	7.83	S. spp: Atlantic: mean over full year: fish flesh (not defined)	20

Selected values

Protein 20.2%
Fat 4.5%

The data collected above include a number of surveys of compositions carried out over one or more years, or for a substantial part of the year. However several are surveys of the composition of whole fish or of headed, gutted fish. Omitting these leaves only the values from sources 17, 19 and 20; 19 refers to a minor species, and 20 gives only fat content, while both refer to flesh, without a clear definition of the term. It would thus appear unwise to rely only on such surveys.

Accordingly, mean values have been calculated of all the data from sources where the material analysed is edible flesh (with or without skin) rather than whole fish, headed and gutted fish, or ill-defined edible flesh.

Sources

1. Bykov, V.P. Marine Fishes. (Russian Translation Series 7, A.A. Balkema, Rotterdam, 1985) pp 80-83

2. Santos, F.O. and Ascalan, S.J. Amount of nutrients in Philippine food materials. Philippine Agriculturist 20 402-409 (1931)

3. Sulit, J.I. et al. Proximate chemical composition of various species of Philippine market fishes. Philippine J. of Fisheries 2 109-122 (1953)

4. Chari, S.T. Nutritional values of some of the west coast marine food fishes of the Madras province. Ind. J. Med. Res. 36 253-259 (1948)

5. Sudhakaran, R. and Sudhakara, N.S. Studies on the preparation of salted and dried minces from threadfin bream (Nemipterus japonicus) and Indian oil sardine (Sardinella longiceps). FAO Fisheries Report No 317, Supplement (1985). Spoilage of tropical fish and product development pp 338-347.

6. Revankar, G.D. et al. Fish mince - preparation and composition. Indian Food Packer 35(4) 20-24 (1981)

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11. Krishnakumar, S. et al. Preservation of Sardinella longiceps in iced and chilled seawater Part 1 Changes during storage with particular reference to bacterial load and nitrogeneous compounds. Fishery Technol. 22 126-131 (1985)

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Sources (continued)

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17. Hale, M.B. Proximate chemical composition and fatty acids of three small coastal pelagic species. Marine Fisheries Review 46(1) 19-21 (1984)

18. Watanabe, K. Variations in chemical composition in some commercial fishes from the south of Brazil. Bull. Jap. Soc. Sci. Fish. 29 469-474 (1963)

19. Nandanie, W.M.C., Jayasinghe, C. and Fonseka, T.S.G. A preliminary study on the seasonal variation in the storage pattern and proximate composition of iced spotted sardine (Sardinella sirm). FAO Fisheries Report No 317, Supplement (1985). Spoilage of tropical fish and product development. pp 82-86

20. Bidenko, M., Shenderyuk, V. and Agzhitova, L. Technology of processing of Atlantic sardine. Fishery Products ed. R. Kreuzer (Fishing News Books, 1974) pp 206-212

SCADS and JAPANESE SCAD and INDIAN SCAD (RUSSELL'S SCAD)

Decapterus spp 1,70(23)043,xx

Decapterus maruadsi 1,70(23)043,07

Decapterus russelli 1,70)23)043,08

Yield

Fillet	Edible Flesh	Comments	Source
50.06-57.0		Decapterus maruadsi: probably includes skin	1
	40.1	D. macrosoma	2
	71.24	D. macrosoma	3
53.0		D. rhonchus: probably includes skin	1
	54.8	D. kiliche: meat with skin	1
56.4		D. polyaspis: probably includes skin	1
	50.6-56.4	D. spp: meat with skin	4

Selected values

Skinless fillets [52%]
Edible flesh [52%]

The value for skinless fillets is the mean of the available data, reduced by 15% to take account of skin. The data for total edible flesh are particularly variable and the selected value, the mean of the data (collected for skin where appropriate), is clearly not compatible with the fillet figure.

Composition

Protein	Fat	Comments	Source
20.9	1.9	D. maruadsi	5
	4.38	D. maruadsi	6
20.7-23.3	0.4-3.5	D. maruadsi	1
20.0-23.8	0.2-0.8	D. russelli	1
19.22	1.65	D. macrosoma	2

Protein	Fat	Comments	Source
21.90	0.95	D. macrosoma	3
21.29	0.43)	D. rhonchus	7
19.0	2.2)		
20.7-21.5	2.9-5.1	D. rhonchus	1
22.22	1.90	D. punctatus	8
21.5	5.0	D. kiliche	1
22.5	4.6	D. polyaspis	1
21.9	2.6	D. spp	4

Selected values

Protein 21.3%
Fat 2.5%

No surveys, even partial ones, were found. The selected values are means of all the data.

Sources

1. Bykov, V.P. Marine Fishes. (Russian Translation Series 7, A.A.Balkema, Rotterdam, 1985) pp 42-45

2. Intengan, C.L. et al. Composition of Philippine foods, V. Philippine J.of Science 85 203-213 (1956)

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Pectinidae	SCALLOPS NEI	3,16(08)xxx,xx
Pecten yessoensis	JAPANESE SCALLOP	3,16(08)003,07
Pecten maximus	COMMON SCALLOP	3,16(08)003,09
Placopecten magellanicus	SEA SCALLOP	3,16(08)014,04
Argopecten gibbus	CALICO SCALLOP	3,16(08)030,01

Yield

Meat	Comments	Source
10-16	Pecten maximus: UK: includes roe	1
13.4	P. maximus: UK: mean of 2 samples: probably includes roe	2
18.0	P. maximus: UK: single sample: probably includes roe	3
8.0	Placopecten magellanicus and Aequipecten (=Argopecten) irradians: USA: does not include roe	4
3.6-4.7	Argopecten gibbus: USA: does not include roe	4
11.5	species not certain: East USSR: may include roe	5

Selected values

Meat, including roe [15%]
Meat, excluding roe [6%]

In USA, only the adductor muscle (meat) is eaten: in most other countries the meat and the gonads are eaten. The available data are limited: no proper seasonal study is available (other than biological studies of growth rates, which do not provide usable data on meat yields) and it is in no case clear whether the initial weight of the whole scallop includes the shell liquor or not. The selected values are the mean of sources 1, 2 and 3 for meat with roe, and the mean of source 4 data for meat only. These values would indicate that roe constitutes more than half the total yield, which is probably untrue. A species difference may account for this apparent discrepancy.

Composition

Protein	Fat	Glycogen	Comments	Source
	0.6		Patinopecten (= Pecten) yessoensis: Japan: muscle: mean of wild and farmed scallops: sampled in 5 months of year	6
16.7	0.46	3.70	Pecten maximus: UK: muscle: 5 batches	7
13.82	1.70	0.24	P. maximus: UK: roe: 5 batches	7
16.0	0.76	2.86	P. maximus: UK: weighted means of muscle and roe, calculated from previous data	7
17.5	0.5-1.0		P. maximus: UK: 1 or 2 samples: probably includes roe	3
17.24	0.46		muscle — Pecten jacobeus:	
18.31	1.22		male roe — Spain: 20 batches	14
13.81	2.72		female roe — over complete year	
17.55	0.50	1.76	Placopecten magellanicus: USA: muscle: means of wild and farmed fish: 2 batches	8
	0.85		P. magellanicus: USA: muscle: sampled 9 months of year	9
15.08	1.00		P. magellanicus: USA: muscle: 2 samples	10
15.85	0.60	4.26	P. magellanicus: USA: muscle: sampled 6 times over year	11
17.1	0.9		P. magellanicus: USA: muscle: single batch	12
18.2	0.17		P. magellanicus: USA: means of 20 specimens	13
15.83	0.58	1.50	Aequipecten (= Argopecten) gibbus: USA: muscle: sampled monthly over 2 years	11
15.4	1.0		Aequipecten (= Argopecten) gibbus: USA: muscle: single batch	12
16.9	0.21		Argopecten gibbus: USA: means of 19 or 20 fish	13
15.70	0.52	1.47	Aequipecten (= Argopecten) irradians: USA: muscle: means of monthly samples over 2 years	11
14.4	0.7		Aequipecten (= Argopecten) irradians: USA: muscle: single batch	12

Protein	Fat	Glycogen	Comments	Source
17.5	0.3	muscle	species not certain: East USSR	5
18.3	0.5	male roe		
13.3	2.4	female roe		
14.1	0.2		Pecten spp: USA: means of 19 or 20 fish	13

Selected values

	Meat including roe	Meat excluding roe
Protein	[16.0%]	15.8%
Fat	[0.8%]	0.6%
Glycogen	[2.9%]	2.4%

The values for edible meat, including roe, are from source 7: they are consistent with data of sources 3, 5 and 14, but are provisional as the survey covered only part of the year and was geographically limited. The values for muscle only, appropriate mainly to USA and Canada, are the means of the three species from source 11.

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SEERFISHES NEI

Scomberomorus spp 1,75(01)015,xx

NARROW-BARRED SPANISH MACKEREL

Scomberomorus commerson 1,75(01)015,03

JAPANESE SPANISH MACKEREL

Scomberomorus niphonius 1,75(01)015,12

Yield

Fillet	Edible Flesh	Comments	Source
59.5		Scomberomorus commerson: includes skin	1
	71.8	S. commerson: includes skin	2
52.3		S. commerson: skinless	3
	63.0	Cybium (= Scomberomorus) commerson	4
	43.6	Cybium (= Scomberomorus) commerson: edible portion not defined	5
	69.18	Cybium (= Scomberomorus) commerson: skinless	6
	66.7 70.1	S. guttatus: includes skin	2
	66.0	Cybium (= Scomberomorus) guttatus: skinless	7
	71.2	S. maculatus: skinless	2
62.0		S. maculatus: probably skinless	2
48.6		S. maculatus: skinless	8
	75.0	S. niphonius: includes skin and bone	2
66.7-73.0		S. leopardus: include skin	2
	66 7-70.2	S. spp: include skin	9

Selected values

Skinless fillets	57%
Edible flesh	67%

The selected values are means of the data, after correcting for presence of skin where necessary. The value for edible flesh from source 5 has been excluded because of doubt about its definition, and the result for S.niphonius, which includes skin and bone (Source 2), has also been omitted.

Composition

Protein	Fat	Comments	Source
20.7	0.9	Scomberomorus commerson: means of 10 fish	1
21.0	2.5	S. commerson	2
17.86		Cybium (= Scomberomorus) commerson	4
15.94	0.21	Cybium (= Scomberomorus) commerson	5
17.29	0.52	Cybium (= Scomberomorus) commerson	6
21.02	0.36	S. commerson	10
19.81	9.68	S. guttatus	10
20.0	2.1	S. guttatus	2
22.45	4.00	Cybium guttatum (= Scomberomorus guttatus)	7
	13.0	S. guttatus	11
	1.723	Cybium guttatum (= Scomberomorus guttatus)	12
21.4	4.2	S. maculatus	2
18.97	13.75	S. maculatus	8
21.08	0.64	S. maculatus	13
19.7	2.5	S. niphonius	2
20.9	8.6	S. leopardus	2
19.0	7.2	S. spp: fat content can vary from 1.5 to 19.2	9
22.37		S. sp	14
20.36	2.67	Scomberomorus & Acanthocybium spp: section of fish analysed	15

Selected values

Protein 20.0%
Fat [4.4%]

The data do not permit one to detect any differences between species, although the fat contents of S. commerson are all quite low compared with the mean. The comment in source 9 about the possible variation in fat content, and knowledge of the seasonal variation of fat content in most other fatty fish, would suggest that in the absence of any data on seasonal variation, the selected mean value for fat may be somewhat low. The protein value is the mean of all data.

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SKIPJACK TUNA

Katsuwonus pelamis 1,75(01)025,01

Surprisingly little data are available on tunas generally, but sufficient on skipjack tuna to warrant separate treatment from tunas in other genera.

Yield

Fillet	Edible Flesh	Comments	Source
	59	sum of light and dark meats: skinless	1
	63.54	Nigeria: recovered by deboning machine	2
45.9		New Zealand: sum of light and dark meats: skinless	3
	65.4	sum of light and dark meats: skinless	4
	60.8–66	includes skin	5

Selected values

Skinless fillets [46%]
Edible flesh 62%

Only one figure is available for fillet yield. The value for edible flesh is a mean of the values above (after subtracting 5% from source 5 data to correct for skin).

Composition

Protein	Fat	Comments	Source
25.2	0.8	weighted mean of values for light and dark meats	1
19.32–27.78 mean 23.64	1.40–3.58 mean 2.10	Nigeria: means over 7 months in 9 month period	6
25.6	8.2	New Zealand: mean of 6 fish: light meat only	3
26.1	2.6	Pacific coast of N & S America: means of 59 summer-caught fish: weighted means of light and dark meat	7

Protein	Fat	Comments	Source
	0.8	India: single fish	8
20.6	1.4	India: single sample (?): weighted means of values for light and dark meat	9
20.6-28.0 mean 24.77	0-11.5 mean 3.45	Several fishing grounds and seasons	4
18.3-26.3	0.4-13.4	February to August	5

Selected values

Protein 24.2%
Fat 3.8%

Data from four sources, 6, 7, 4 and 5 cover either an extended period or an extended geographical range. Values from these have been averaged to give the selected values.

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SQUIDS, CUTTLEFISHES, OCTOPUSES

The following species and groups come within the scope of the study.

CUTTLEFISHES, BOBTAIL SQUIDS

Sepia, sepiola spp — 3,21(02)xxx,xx

COMMON SQUIDS

Loligo spp — 3,21(04)001,xx

ARGENTINE SHORTFIN SQUID

Illex argentinus — 3,21(05)010,03

JAPANESE FLYING SQUID

Todarodes pacificus — 3,21(05)058,03

OCTOPUSES

Octopodidae — 3,21(09)xxx,xx

SQUIDS NEI

Loliginidae, Ommastrephidae — 3,99

Yield

Edible parts of these species may comprise the mantle (M), the tentacles (T) and (especially in the case of octopus) part of the head (H). The nature of the edible part is in the second column. Data for wings (fins) is included in mantle data. Where the edible flesh has been stated to be skinned, this is noted in the comments column; it is likely that most of the data refer to skinless meat, even though this is not stated.

Edible	Parts	Comments	Source
57.96	M+T	Sepia officinalis: Spain: mean of 5 specimens	1
68.56	?	Sepiella inermis: India	2
77.45	M+T	Loligo vulgaris: Spain: mean of 5 specimens	1
71.38	?	Loligo indica: India	2
71.27	M+T	Loligo spp: Spain: skinless	9
65	M+T	Illex illecebrosus: Canada: skinless	15
62	M+T	Illex illecebrosus	1
45.2 15.8	M) T)	Todarodes sagittatus: mantle yield from samples collected in 7 months of year, tentacle yield from 2 months	16
66.5	M+T	Todarodes pacificus: Pacific: mean of 6 specimens	17

Edible	Parts	Comments	Source
41.1 22.8	M) T)	Notodarus spp: New Zealand: means of 70 specimens caught during year: skinless	19
79.04	M+T	Ommastrephes sloani pacificus: Japan: mean of 10 specimens caught July to December	20
53.9 9.4	M) T)	Sepioteuthis bilineata: New Zealand: means of one batch of 6 specimens : skinless	19
41.6 22.5	M) T)	Moroteuthis ingens: New Zealand: means of one batch of 6 specimens: skinless	19
63	M+T	means of 9 species of Pacific squid: 1 to 3 specimens of each	17
78.6	H+T	Octopus vulgaris: Spain: mean of 4 specimens	1

Selected values

Cuttlefishes, bobtail squids	[63%]
Squids	67%
Octopuses	[79%]

The paucity of data on yields of cuttlefish (Sepia and Sepiella, sources 1 and 2) and octopus (source 1), in comparison with the fair amount of data on squids, does not allow one to decide whether they are significantly different from yields of squid. However, since they are dissimilar in appearance from squid and might be expected to give different flesh yields, separate provisional yield figures are suggested. The value for squid is the mean of all the data, in the absence of any full survey, or evidence of a species or genus difference.

Composition

Protein	Fat	Parts	Comments	Source
18.04	1.44	?	Sepia officinalis: Mediterranean	4
20.55	1.40	?	Sepiella inermis: India	2
15.94	0.77	M	Sepia orientalis: India	3
19.6		M+T	Sepia aculeata: India	5
15.6	1.28	M	Sepia esculenta: Japan	6
20.2	1.36	M	Sepia pharaonis: Japan	6
	0.6	?	Sepia sp: India	7

Protein	Fat	Parts	Comments	Source
14.15	1.48	?	Sepia sp: Mediterranean	8
17.4 17.2	2.79 2.39	M) T)	Loligo vulgaris: Atlantic	10
16.52	0.81	M	Loligo vulgaris: India	3
17.1	1.3	?	Loligo vulgaris: South Africa	11
20.1	1.40	M (without fins)	Loligo forbesi: UK	12
20.83	1.35	?	Loligo indica: India	2
16.33	1.67	M	Loligo pealei: USA	13
14.5	0.9	M+T	Loligo pealei: USA: skinless	14
19.6	2.74	M	Loligo opalescens: Japan	6
16.30 15.70	0.11 0.12	M) T)	Loligo spp: Spain: skinless	9
	0.8	?	Loligo sp: India	7
12.72	1.75	?	Loligo sp: Mediterranean	8
18 19	1.0 0.6	M) T)	Illex illecebrosus: Canada	15
17.6 18.2	2.70 2.70	M) T)	Illex coindeti: Atlantic	10
16.7	0.5	M+T	Illex opalescens: USA: skinless	14
18.2	2.03	M	Illex argentinus: Japan	6
21.5 22.0	0.2 0.3	M) T)	Todarodes sagittatus: Atlantic	18
19.0 18.8	0.3 0.4	M) T)	Todarodes sagittatus: sampled in 7 months of year	16
20.2	1.92	M	Todarodes pacificus: Japan: means of 2 specimens	6
20.4	1.3	?	Todarodes pacificus: Pacific: means of 6 specimens	17
19.4	1.66	M	Notodarus sloani: Japan: means of 2 specimens	6
19.2	1.7	M+T	Notodarus spp: New Zealand: means of 70 specimens caught during year	19

Protein	Fat	Parts	Comments	Source
19.9	1.46	M+T	Ommastrephes sloani pacificus: Japan: mean of 10 specimens caught July to December	20
18.8		M	Ommastrephes sloani pacificus	21
21.5	1.43	M	Ommastrephes bartrami: Japan: means of 3 specimens	6
18.1-23.1	2.9-3.7	?	Ommastrephes sp: Japan	22
19.1	1.9	M+T	Sepioteuthis bilineata: New Zealand: means of one batch of 6 specimens	19
14.1	1.3	M+T	Moroteuthis ingens: New Zealand: means of one batch of 6 specimens	19
18.5	1.79	M)		
16.6	1.29	T)	Sthenoteuthis pteropus: Atlantic	10
17.2	1.4	M+T	means of 9 species of Pacific squid: 1 to 3 specimens of each	17
17.94	0.75	?	Octopus vulgaris	23
	0.5	?	Octopus vulgaris	24
	0.8	?	Octopus variabilis	24
15.6		?	Octopus dofleini	21
13.2	0.83		Paroctopus hongkongensis	25

Selected values (all species)

Protein 17.9%
Fat 1.3%

There appears to be no significant difference between the compositions of mantle and tentacles nor between cuttlefish, squid and octopus. The selected values are means of all the data. These species have more connective tissue than finfish and the quality of their protein might be expected to be lower. Two investigations (sources 13 and 14) have indeed found lower protein efficiency ratios for squid than for finfish, but the difference is unlikely to be important overall.

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TILAPIAS NEI

Sarotherodon, Tilapia spp 1,70(59)052,xx

and

CICHLIDS NEI

Cichlidae 1,70(59)xxx,xx

No data on cichlids other than tilapias have been found, so application of the conclusions to cichlids, generally, must be regarded as tentative.

Yield

Fillet	Edible Flesh	Comments	Source
	40.1	Tilapia nilotica: by deboning machine	1
	35.9	T. nilotica: mean of 9 fish: edible portion inadequately described	2
	38.0	T. nilotica	3
	27-43	T. mossambica	4
	25.3	T. spp.: based on gutted weight: by deboning machine	5

Selected values

Skinless fillet [37%]
Edible flesh 37%

The fillet value is based on the corresponding figures for Cyprinids nei and Characins nei, but is clearly not consistent with the edible flesh value. The edible flesh value is the mean of data from sources 1, 2, 3 and 4. The data from source 5 seem too low, especially as they are based on gutted weight.

Composition

Protein	Fat	Comments	Source
16.48	1.18	T. nilotica	6
17.10	1.8	T. nilotica	1
18.69	0.36	T. nilotica	2
20.0	2.2	T. nilotica	7
	1.71	T. nilotica: white meat only	8
14.0-20.6	0.1-8.4	T. mossambica	4
18.60	2.20	T. mossambica	9
17.06		T. mossambica: small piece of fish analysed	10
15.25	2.95	T. spp	5
22.4	5.1	Sarotherodon spp: may be analyses of whole fish	11

Selected values

Protein 17.6%
Fat 2.1%

The chosen values are the means of the data above, omitting those from sources 8, 10 and 11.

Sources

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TOLI SHAD

Hilsa toli **1,21(05)034,04**

Data for Hilsa ilisha have been collected in addition to data for Hilsa toli.

Yield

Fillet	Edible Flesh	Comments	Source
	59	Clupea (= Hilsa) toli	1
	60	Hilsa ilisha	1

Selected values

Skinless fillets [50%]
Edible flesh [60%]

The value for skinless fillets is derived from values for other Clupeidae in the absence of any collected data. The edible flesh value is from the source 1 data: it is very provisional but is not too dissimilar from values for other Clupeidae.

Composition

Protein	Fat	Comments	Source
17.98		Clupea (= Hilsa) toli: marine	1
	0.715	Clupea (= Hilsa) toli: marine	2
21.52		Hilsa ilisha: marine	1
21.8	19.4	Clupea ilisa (= Hilsa ilisha): freshwater	3
	12.8	Clupea (= Hilsa) ilisha: marine	4
17.02	9.85	Hilsa ilisha	5
20.60	20.11	Hilsa ilisha: marine	6

Selected values

Protein 19.8%
Fat [12.6%]

Like other clupeids, toli shad would be expected to have a quite variable fat content. No survey which demonstrates this is available: the collected data seem to come from a few random samples. The selected value for protein is the mean of all the data and is consistent with other species. The selected value for fat, again the mean of the data, is more doubtful in the absence of a survey.

Sources

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TRIGGERFISHES, DURGONS

Balistidae 1,89(03)002,xx

FILEFISHES

Cantherines (= Navodon)spp 1,89(03)004,xx

THREADSAIL FILEFISH

Stephanolepis cirrhifer 1,89(03)010,01

Yield

Fillet	Edible Flesh	Comments	Source
	32.7	Navodon scaber: New Zealand: mean of 6 fish	1

Selected values

Skinless fillets [33%]
Edible flesh [36%]

The skinless fillets value is based on a single result and is provisional; the edible flesh value, also provisional, is derived on the particularly tenuous basis of a superficial resemblance to Leiognathidae.

Composition

Protein	Fat	Comments	Source
18.20	1.63	Balistoides viridescens: Red Sea: means of 4 fish	2
20.0	< 2.0	Balistes capriscus: Atlantic	3
19.4	0.3	Balistes spp: Ghana: probably includes skin and bone	4
18.8	0.22	wild) Navodon modestus:	
19.5	0.46	farmed) Japan: means of 3 fish	5
18.5	0.9	Navodon scaber: New Zealand: means of 6 fish	1
19.8	0.21	wild) Stephanolepis cirrhifer:	
20.3	0.50	farmed) Japan: means of 3 fish	5
16.61	0.93	Odonus niger: Red Sea: means of 4 fish	2

Selected values

Protein	18.8%
Fat	0.7%

Selected values are means of the collected data, but omitting the farmed fish results and ignoring the fat content of < 2.0% from source 3.

Sources

1. Vlieg, P. Proximate analysis of commercial New Zealand fish species. 2. New Zealand J. of Sci. 27 427-433 (1984)

2. Hanna, R.G.M. Proximate composition of certain Red Sea fishes. Marine Fisheries Review 46(3) 71-75 (1984)

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TUNAS

Tunas and bonitos belong to several genera, but are a recognisable group of the larger mackerel-like fish. Insufficient data are available on any single species, with the exception of skipjack tuna: the latter is given separate treatment, while the following species falling within the scope of the study are dealt with together here.

	FRIGATE AND BULLET TUNAS	
Auxis thazard, A. rochei		1,75(01)023,XX
	KAWAKAWA	
Euthynnus affinis		1,75(01)024,06
	NORTHERN BLUEFIN TUNA	
Thunnus thynnus		1,75(01)026,01
	ALBACORE	
Thunnus alalunga		1,75(01)026,05
	SOUTHERN BLUEFIN TUNA	
Thunnus maccoyii		1,75(01)026,08
	YELLOWFIN TUNA	
Thunnus albacares		1,75(01)026,10
	BIGEYE TUNA	
Thunnus obesus		1,75(01)026,12

Data from other species, including Sarda spp, are collected here together with the above species.

Yield

Fillet	Edible Flesh	Comments	Source
	56.8	Sarda chiliensis: flesh with skin	1
	58.0	Sarda chiliensis: may include skin	2
	44.9	Auxis thazard: sum of light and dark meats: Indian Ocean	3
	55.7	A. thazard: sum of light and dark meats	4
	57.5	A. thazard: mean of three grounds: may include skin	5
	74	Euthynnus alletteratus: probably includes skin and bones	6
	54.8	E. alletteratus: sum of light and dark meats	3
	57.8	E. alletteratus: sum of light and dark meats	4
	54.7	E. alletteratus: may include skin	5
	63.6	Thunnus thynnus: may include skin	5

Fillet	Edible Flesh	Comments	Source
	61.6	T. thunnus (= T. thynnus)	7
31.7	69.0	T. alalunga: skin-on fillets: edible flesh by deboning machine	8
	54-58	Germo alalunga (= T. alalunga) probably includes skin	7
	48.7	T. maccoyii: sum of light and dark meats	3
	61.0	Thynnus macropterus (= Thunnus albacares): India: may include skin	9
	76.6	Neothunnus macropterus (= Thunnus albacares): may include skin and bones	10
	53 9-66.8 mean 62.0	Neothunnus albacore (= Thunnus albacares)	11
	72-79.2	T. albacora (=T. albacares): includes skin and bones	12
	64.6	Neothunnus albacora (= Thunnus albacares): sum of light and dark meats	7
	74 8-77.3	Thynnus obesus (= Thunnus obesus): includes skin and bones	12
	63.2	Parathunnus obesus (= T. obesus): light and dark meats	7

Selected values

Skinless fillets [30%]
Edible flesh 58%

The only available figure or fillet yield is reduced by 5% to take account of skin. The data for total edible flesh are quite variable, though there is no clear evidence for species difference. Ten values are available for flesh, free of skin and bones, varying from 44.9% to 69.0%: the selected value is the mean of the ten values.

Composition

Protein	Fat	Comments	Source
22.96	4.28	Sarda sarda: South Africa: mean of 6 fish caught at same time	13
23.0	5.9	S. sarda	5
22.62	10.21	S. chiliensis: California: means of 7 fish caught in September (fat content 19.21) and May (fat 1.21)	14
21	4.5	S. chiliensis: Peru	2
24.73	3.29	Auxis thazard: Indian Ocean: weighted means of data for light and dark meats	3
25.7	1.7	A. thazard: weighted means of data for light and dark meats	4
21.5	3.7	A. thazard: west Africa	15
21.3	7.8	A. thazard: mean of three grounds	5
22.5	1.6	Euthynnus alletteratus: includes skin	6
25.0	2.5	E. alletteratus: weighted means of data for light and dark meats	4
24.5	2.9	E. alletteratus	5
18.8	3.4	E. affinis: India: weighted means of data or light and dark meats	16
24.78	5.22	Thunnus thynnus: California: means of 10 fish caught in July and September	14
24.4	8.8	T. thynnus: South Africa: nape flesh: means of 5 fish	17
21.5	14.6	T. thynnus: Norway: shoulder meat: means of three consecutive monthly samples	18
25.0	5.3	T. thynnus: Pacific Ocean: weighted means of data for light and dark meats: means of 19 fish	19
18.8	8.9	T. thynnus	5
23.8	9.6	Germo alalunga (= T. alalunga)	20
24.06-26.69 mean 25.59	4.35-12.76 mean 6.95	T. alalunga: California: means of lots of 5 fish caught over 6 month period	14

Protein	Fat	Comments	Source
26.0	5.9	T. alalunga: South Africa: nape flesh: means of 5 fish	17
24.00	10.51	Germo alalunga (= T. alalunga): Pacific: means of 24 fish	21
21.57	6.82	T. alalunga: Spain: single sample	22
24.8		T. alalunga: single sample	8
25.0	9.7	G. alalunga (= T. alalunga): west coast USA: weighted means of data for light and dark meats: 60 fish: summer	19
26.6	1.2	G. alalunga (= T. alalunga): Japan: weighted means of data for light and dark meats: 8 fish: May/June	19
23.3	6.4	T. alalunga	5
24.72	1.29	T. maccoyii: Indian Ocean: weighted means of data for light and dark meats	3
24.4	3.0	probably T. maccoyii: Australia: mean of 4 fish	23
24.1	0.8	Neothunnus albacore (= Thunnus albacares): Indian Ocean: white meat only	11
22.7	0.18	Neothunnus macropterus (= T. albacares): Philippines	10
23.84	1.59	Thynnus macropterus (= T. albacares): India	9
26.2	9.6	Neothunnus macropterus (= T. albacares)	20
24.67	3.05	T. albacares: mean of 30 fish caught May, September and October	14
26.8	1.9	T. albacares: mean of 5 fish: nape flesh	17
24.78	0.73	Neothunnus macropterus (= T. albacares)	24
25.2	1.57	N. macropterus (= T. albacares): weighted means of data for light and dark meats	19
24.3	1.3	T. albacares	5
23.13	0.41	T. obesus: Gulf of Aden	3
24.4	4.2	T. obesus: South Africa: 12 fish: nape flesh	17

Selected values

Protein 23.7%
Fat 4.6%

Some sources give separate data for the light (or white) and dark (or red) meats of tunas. The reasons are that the dark meat is particularly noticeable in tunas and that, commonly, the canning of tuna uses only the light meat. In the tabulated data above, figures for light and dark meats have been combined using weight ratios of light to dark meat for the actual, or a related, species as given in sources 3 and 11. Where the data do not differentiate between light and dark meats, it has been assumed that the analyses were carried out on the mixed meats.

Although tunas, like mackerels, would be expected to show clear seasonal variation in composition, especially in fat content, only two extended studies have been found in the present survey. These are in sources 11 and 25. However, source 11 gives analyses of light meat only, while source 25 (not quoted in the tabulated data above) gives results for flesh, bones and skin mixed together; the results of these two sources cannot therefore be directly used to give a measure of the variation in composition of total meat.

The selected values are based on an overall mean of all data excluding those from source 11 (white meat only), source 17 (nape flesh, not defined), 18 (shoulder meat, not defined) and 6 (includes skin).

Sources

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Sources (continued)

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WHITING

Merlangius merlangus 1,48(04)034,01

Yield

Fillet	Edible Flesh	Comments	Source
38		skinless: based on gutted, head-on weight	1
63.6		includes skin: based on gutted, head-on weight	2
38		skinless: based on gutted, head-on weight	3
24.4-46.5 mean 34.9		skinless: based on gutted, head-on weight: mean of 364 fish caught over complete year	4
	51.9	includes skin	5

Selected values

Skinless fillets 32%
Edible flesh [49%]

The value for skinless fillet yield is the mean of the data of sources 1, 3 and 4, converted to a whole fish basis using a factor from source 6; the figure from source 2 seems too high (even if converted to skinless basis). The value for total edible flesh is that from source 5, corrected for presence of skin. It is higher than the values selected for most other gadoid species.

Composition

Protein	Fat	Comments	Source
17.7	0.4	mean of small number of fish	1
14.69-20.94 mean 18.20		mean of 365 fish caught over complete year	7
17.4	0.3		5

Selected values

Protein 18.2%
Fat [0.4%]

The protein value is from the full survey in source 7: the fat value is provisional as the available data are for a small number of fish.

Sources

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